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How Expectations of Mobile Device Features Could Impact Desktop Software Design

CAPSTONE REPORT

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Abstract

Prevalence of mobile computing technologies has led to astounding changes in the way people work; changes don't always harmonize across the mobile / desktop computing continuum. This annotated bibliography reviews popular features of selected mobile devices concerning mobile tasks, mobile technologies and mobile context in order to examine the impact of user expectations on desktop computing software development. Developers should consider communications, customization, and portability, with the goal to create a unified experience across interfaces.

Keywords: mobile devices, mobile features, desktop design, user interface, user preference

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Introduction to the Annotated Bibliography

Problem

Increased computational power and mobile technology development. As the personal computer (PC) market began to flourish, Chandrakasan, Sheng, and Brodersen (1992) observe intensified research and development focusing on increasing the computational power of smaller processing platforms. They state that by "increasing the speed of digital systems, present-day technologies possess computing capabilities that make possible powerful personal workstations, sophisticated computer graphics, and multimedia capabilities such as real-time speech recognition and real-time video" (p. 473). Chandrakasan et al. (1992) go on to identify user demands for more sophisticated devices,

> …high-speed computation has thus become the expected norm from the average user, instead of being the province of the few with access to a powerful mainframe. Likewise, another significant change in the attitude of users is the desire to have access to this computation at any location, without the need to be physically tethered to a wired network. The requirement of portability thus places severe restrictions on size, weight, and power. (p. 473)

Mobile technology and market share. Murphy and Meeker (2011) tag the end of 2010 as the inflection point when the number of mobile devices (i.e., smartphones and tablets) shipped to resellers is greater than the number of PC's shipped to resellers (see Figure 1) and indicate the steep 173% growth-rate for the category. With a foundation of the popular iPod line of music players, Apple introduces their mobile operating system (iOS) in 2007 and in 2010 the iPad (an iOS-based) tablet computer, instantly became a success (Middleton, 2010; G. D. Murphy, 2011).

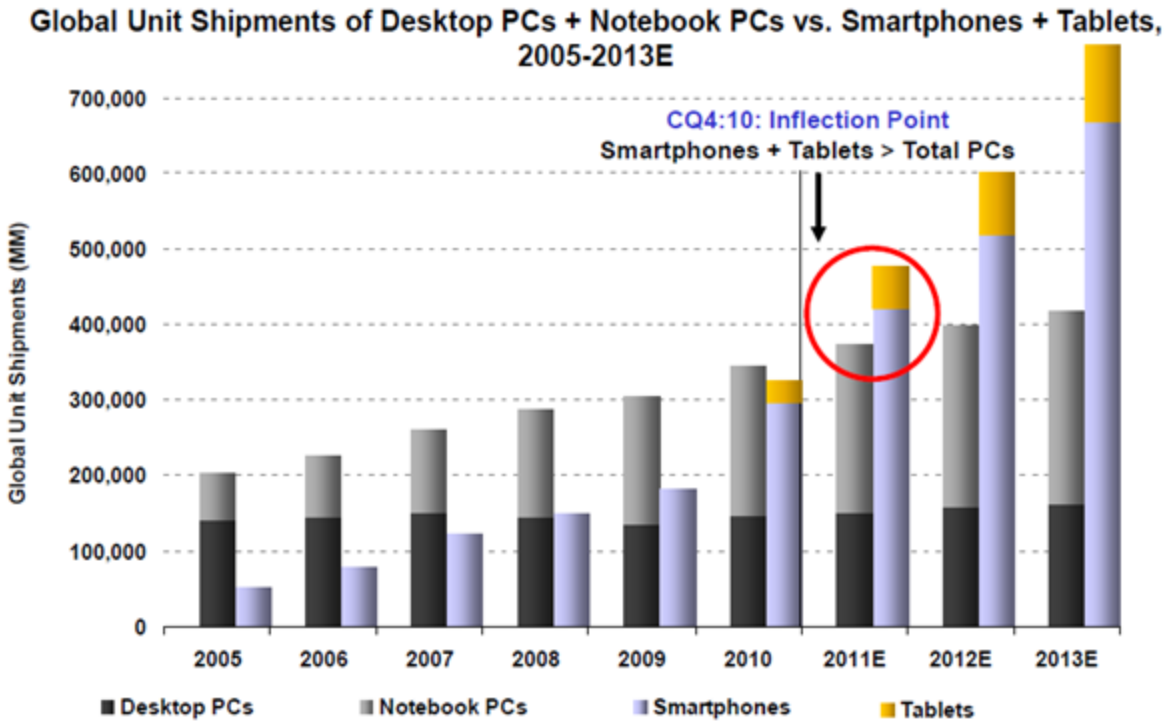

Figure 1. Global shipments mobile devices vs. PC's (M. Murphy & Meeker, 2011, p. 7)

Mobile devices, the Internet, and the experience. When describing the development of the smartphone market, West and Mace (2010) note that Apple successfully used their position as a premier computer hardware manufacturer to shift the focus from a vehicle for a voice communications, onto mobile Internet platforms (p. 19). They report:

> There were two keys to Apple's successful entry into mobile telecommunications. First, it gained market entry by redefining the mobile phone to create the new dominant design for mobile Internet devices. Secondly, it leveraged its systems capability to establish a permanent position of value capture in mobile phone industry. (p. 18)

While identifying Apple's strength in providing widely-embraced Internet devices like the iPhone and iPad, West and Mace (2010) further clarify another Apple advantage: an integrated computing ecosystem or *mobile and wireless infrastructure software platform*.

> Apple's second (and likely more durable) source of advantage came from its integrated approach that leveraged its decades-long systems competencies in hardware, software, and system design. For the iPhone, the company built upon both these general competencies and the specific parts of the value proposition it developed for the iPod and iPhone. (p. 19)

As West and Mace (2010) observe in the preceding quote, Apple uses its interconnected infrastructure of hardware, software and operating system to provide an enhanced user experience through a simple consistent user interface. This approach is "not new for Apple as it has already been adopted for its personal computers" observe Holzer and Ondrus (2011), noting this as a strategy that "enhances device standardization of the devices and lower dependance [sic] on various device manufacturers" (p. 26).

As of the second quarter of 2010, Android officially bested Apple's consistent 15% iOS platform market share of smartphone sales and by the third quarter of 2010 Android's lead was over 10% greater than iOS (Querbes-Revier, 2011, p. 13). A success due to Android's open development platform (i.e. there is no charge for manufacturers to use the Android OS anywhere they choose, as opposed to Apple's iOS which is a closed OS environment). Sharma (2011) states that Google dominates the smartphone and tablet markets "Android phone market has grown almost doubled[sic] over the past year while the iPhone has lost over those same periods" (p. 1969). Nielson data (see Figure 2) of smartphones OS usage distribution from the third quarter of 2011 indicates only three dominant players: the iPhone, the Android, and the Blackberry.

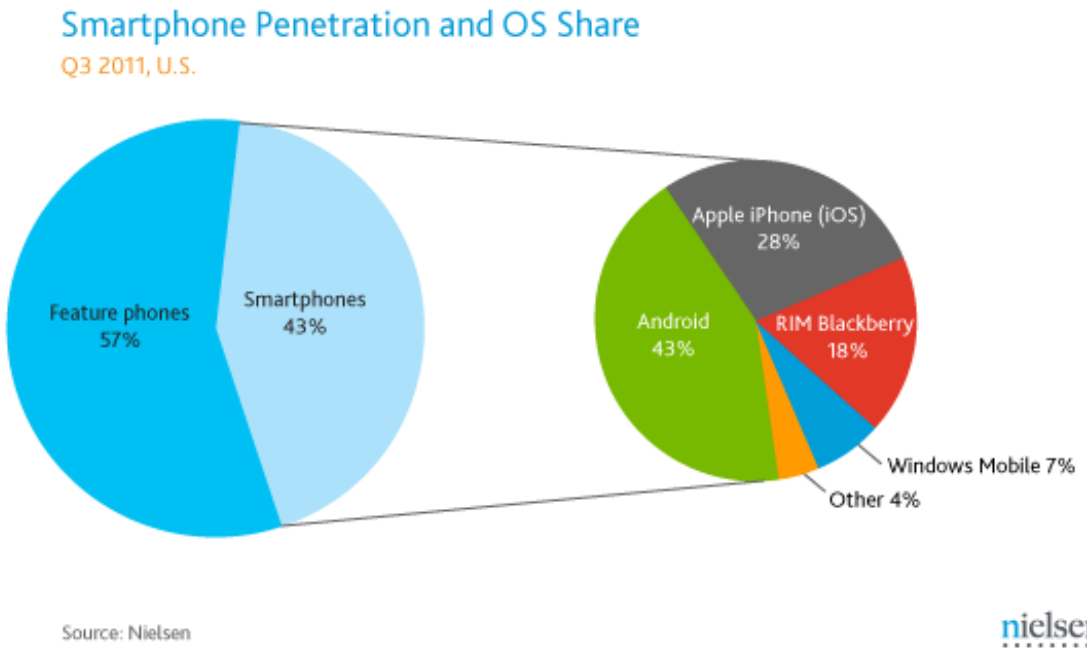

Figure 2. Smartphone market share and OS distribution of smartphones (Nielsen, 2011).

Mobile technology and the application store. Part of the draw among mobile technology users to smartphones, over what are termed *feature phones* (a mobile device with fewer features), is the users' ability to customize the computing experience. Thottam (2005) describes "an explosion" in the growing $2.6 billion dollar market of ring tones, games, and wall-papers for customers seeking personalization.

As a precursor, sales of personal ring tones helped to define the economy of the mobile ecosystem. The ring tone market established a mental model for concept of the *app store* (e.g. an application market) where users acquire software to personalize a device to their needs (Xia, Rost, & Holmquist, 2010, p. 7). Mobile manufacturers and others stepped up, "since the mobile application development landscape has substantially changed over the past several years, mobile development platforms have become more integrated and generally play the role of application portal, device manufacturer, or even both" (Holzer & Ondrus, 2011, p. 30). These application

portals contribute to the disparity of expectations mobile and the desktop users have for getting new software applications.

Beyond offering a portal or app store, further usage segmentation is found related to the vendor business models, revealing differences in how they approach offerings to their users. “RIM mainly focuses on business users; Apple's more strict verification approach strengthens its exceptional user experience and quality focus; and Google's approach with different hardware providers and less strict verification supports a best value for money, mass market strategy” (Müller, Kijl, & Martens, 2011, p. 72). All of which contributes to the disparity between the mobile platform and the desktop.

Statement of Purpose

The purpose of this annotated bibliography is to identify popular features of mobile computing environments, in order to examine the impact of user expectations on desktop computing software development. As Gebauer (2008) summarizes, there are opportunities for additional areas for research as “we see a need to assess in more detail the subtle changes that occur when users start to adapt their work-related tasks to mobile environments (cited in Zheng & Yuan, 2007)” (p. 32). In their earlier work, Yuan and Zheng (2005) develop a theory to “fully understand the nature of mobile workers” which they use to explore key differences between mobile and office workers. As part of this theory, Yuan and Zheng (2005) analyze “four fundamental aspects of mobile work: mobile workers, mobile tasks, mobile context, and mobile technology” (p. 2). Their paper contrasts the stationary (desktop) work environment to the mobile work environment considering the worker, the task of the worker, the context of that task in space and time, and the technology used in that work. The *worker* is more generally categorized as a knowledge worker who spends more than 20 percent of their time away from the

office or desk (p. 2). The *task* refers to the activities performed by mobile workers to accomplish an objective (p. 2). *Context* addresses both where and when a task is completed (p. 3), delineating where the work is being done and the temporal structure of the task. The *technology* refers to not only the mobile hardware but also the infrastructure supporting that hardware.

Generally, software developers who cater to the expectations of knowledge workers find success; as noted by Petter (2008), "if users have improper assumptions about the features that will be delivered, then users may perceive that the functionality objectives associated with project success have not been met" (p. 701). This annotated bibliography examines the potential for user expectations of mobile device features to impact desktop computing software development. Three of the four aspects of mobile work provided by Yuan and Zheng (2005) are used to help frame user expectations of mobile device features: (a) mobile tasks, (b) mobile context, and (c) mobile technology.

Audience

This bibliography is designed to help *business analysts* and *system analysts* who are creating the next generation of desktop application software to consider the mobile technology trends and reported user expectations. The business analyst, or as Sheard (1996) considers them process engineers, are the ones who do "systems engineering" and "are also expected to document, follow, own, and improve the project's and the organization's systems engineering processes. This role also calls for defining and capturing systems engineering metrics" (p. 4).

System analysts use the requirements captured by the business analysts and see that they are "converted into software systems requirements" and "documented in the systems requirement specifications (SRS) document" (Sudhakar, 2010, p. 35). Graf and Misic (1994) clarify the role as, "defining the person (or persons) who play the most critical role in systems development, and

who have the ultimate responsibility of overseeing the system project from inception to maintenance" (p. 15). Grasso and Martinelli (2007) note that "educating engineers more broadly will not only make them better designers, but will also give them the tools to work productively alongside the other problem solvers they will be increasingly required to collaborate" (p.B8). The assumption underlying this study is that given an awareness of the user preferences and expectations of mobile computing features, analysts will be able to execute desktop computing design decisions aligned to the customer expectations.

Significance

Fisher (2003) believes that "system development is difficult not because of the complexity of technical problems, but because of the social interaction between users and system developers as they learn to create, develop, and express their ideas and visions" (p. 233). As developers mature in their craft, there is a tendency to focus into a specific domain; drawing into an almost myopic focus. Shaw (1990) observes that "as software practice matures toward engineering, the body of substantive technical knowledge required of a designer or developer continues to grow. In some areas, it has long since grown large enough to require specialization…" (p. 23) and with that specialization, comes isolation from trending technologies. Informing the development community is important.

Gebauer (2008) observes a need to further research adaptations of work-related tasks made by mobile technology users (p. 32). Evidenced in the research, Gebauer concluded two areas of influence with respect to user-anticipated utility: (a) there are inherent differences in how work is accomplished in a mobile v. non-mobile environment and (b) there is a need to consider non-functional features, such as usability, portability and availability, in addition to functionality when characterizing suitability of mobile technology in various contexts (p. 31).

Research Questions

This study is an exploration of user's expectations of mobile device features within the larger mobile computing environment and the potential impact on desktop computing software development.

Main question. What user expectations of features of the mobile computing environment impact the user expectations of features of the desktop software environment?

Sub-questions.

- When using smartphones and tablets, what features of *mobile tasks* (Yuan & Zheng, 2005) are preferred by users?
- When using smartphones and tablets, how does the *mobile context* (Yuan & Zheng, 2005) influence user preferences?
- When using smartphones and tablets, what features of the *mobile technology* (Yuan & Zheng, 2005) do users prefer?

Delimitations

Time frame. The June 2007 release of Apple's iPhone was a pivotal moment in the mobile industry—in two quarters selling in excess of 3.4 million iPhones and placing Apple in the number 2 position with a 28% share only behind Research In Motion (West & Mace, 2010, p. 11). The iPhone represents a truly integrated "smartphone," thus research preference will be given to materials 2009 or later—excluding sources older than 2000 (except for some reference works predicated on earlier materials.) The author's selection of the 2009 date stems from the 2008 software update to the iPhone platform which increased browsing speed and reliability. West and Mace (2010) also note the rapid adoption of Apple as the platform of choice for mobile Web browsing "at the end of 2009, the iPhone and its cousin the iPod Touch together accounted

for 49-70% of all mobile Web browsing in the US, UK, Germany, and France" (West & Mace, 2010, p. 14).

Focus. This annotated bibliography is intended to identify user expectations of mobile computing features and how these may impact desktop software development. Focus is on two preselected types of mobile computing: (a) smartphones, and (b) tablets. Information about the mobile markets reflects European and North American markets for mobile devices, given that major commercial platform providers from East Asian, Japanese and South Korean have radically different influence (Holzer & Ondrus, 2011, p. 23).

Selection criteria. Literature selections are based on authority, objectivity, quality, coverage and currency with respect to the research methodology as derived from University of Oregon guidelines (Bell & Smith, 2009). Accordingly, materials selected for inclusion in this annotated bibliography are cited in at least two scholarly publications though most are referenced in three or more.

Exclusions. For the purposes of this annotated bibliography, theoretical research on aspects of human-computer interactions, learning interfaces, and particularly adaptive interfaces, distributed cognition, investigations in the theoretical aspects of cognition are not addressed.

Reading and Organization Plan Preview

Reading plan. To ensure a consistent perspective and treatment, collected references related to the topic of this study are selected and reviewed according to the conceptual analysis methodology identified by Busch, De Maret, Flynn, Kellum, Le, Meyers, Saunders and White (2011). Reference selections are made following the plan: (a) establish relevance of selection; (b) evaluate the information source according to Bell and Smith (2009); (c) collect and review the

abstract and citation; (d) code the selected literature according to reading plan; and (e) annotate references with relevant coding information.

The coding process in the reading plan is based on the conceptual analysis process described by Busch et al. (2011) and begins with developing research questions and choosing relevant coding terms and phrases in order to code the text into manageable content categories. The process of coding is basically one of selective reduction. By reducing the text to categories consisting of a word, set of words or phrases, the researcher can focus on, and code for, specific words or patterns that are indicative of the research question.

Organizational plan. Structured as a thematic review, the literature selections in this Annotated Bibliography are "organized around a topic or issue" (University of North Carolina, n.d.). Organization of this bibliography aligns selected references to themes embedded in the sub-questions: (a) the influences of smartphone and tablet usage on mobile tasks (Yuan & Zheng, 2005); (b) environmental use factors that frame the mobile context for the use of technology and tasks being completed (Yuan & Zheng, 2005); and (c) identification of technical features that contribute to user preferences (Yuan & Zheng, 2005).

Definitions

Definitions are drawn from references selected for inclusion in this annotated bibliography. Definitions provide clarification and context for terminology as used throughout.

Business-to-business is generally considered trading between firms (and not between businesses and consumers), characterized by (a) relatively large volumes, (b) competitive and stable prices, (c) fast delivery times and, often, (d) on deferred payment basis. In general, wholesaling is B2B and retailing is B2C (BusinessDictionary.com, n.d.).

Cloud, the cloud, or *cloud computing* as defined by Gartner refers to a style of computing where scalable and elastic IT-enabled capabilities are delivered as a service using Internet technologies. First and foremost is the concept of delivering services—that is, results as opposed to components (IT definition and glossary, n.d.)

Compute ecosystem consists of all things in an individual's environment powered by a microprocessor and all elements of the "infrastructure" that supports it (Heymans & Baird, 2000), typically comprised of the software and operating system platform, hardware platform, networking services used to process transactions or access information.

Desktop system is the author's reference to any conventional personal computing platform (i.e. non-mobile general purpose personal computer, laptop, or netbook.)

Disruptive technology is any new way(s) of doing things that disrupt or overturn the traditional business methods and practices. For example, steam engine in the age of sail, and internet in the age of post office mail (BusinessDictionary.com, n.d.).

Feature phone is a term that's used to describe a low-end mobile device that doesn't have the computing power of a smartphone (Shi, n.d.).

Fixed data user is “an individual with a stationary computer or terminal that requires data transmission to and from a network. Contrast with *mobile data user* (The Free Dictionary, 1981, 2011).

Integrated computing ecosystem refers to *compute ecosystem* infrastructure provided by a single or monolithic agent providing a cohesive user experience through the entire operation spectrum of operation (West and Mace, 2010).

iOS is an Objective-C based operating system used for specific Apple devices like the iPod Touch, iPhone, and iPad line of products. iOS uses a Software Development Kit (SDK) to compile code specifically for Apple devices and therefore it runs very fast (Collotta, Pau, Salerno, & Scatà, 2011, p. 262).

Mobile computing / *Mobile networking* include what is commonly known as the “smart phone” market, in particular, the iPhone. For the purposes of this document, mobile computing does not include most tablets or most tech devices out there (BusinessDictionary.com, n.d.).

Mobile ecosystem embodies a subset of the *compute ecosystem* for portable devices including smartphones and tablet systems including a market of available applications, device accessories, software developers, wireless connectivity and carriers, and the installed user base of skilled users.

Mobile and wireless infrastructure software platforms refer to the development tools and deployment servers are used to create brand-new customer mobile applications or to "mobilize" established conventional enterprise applications, e-mail and enterprise data stores (IT definition and glossary, n.d.)

Mobile data user is "a roving individual with a smartphone, pager, PDA or other handheld device that requires wireless data transmission. Contrast with *fixed data user"* (The Free Dictionary, 1981, 2011).

Smartphone is any "mobile phone which includes functions similar to those found on personal computers. Smartphones provide a one-stop solution for information management, mobile calls, email sending, and Internet access. Smartphones are compact in size and often only slightly bigger than standard mobile telephones" (BusinessDictionary.com, n.d.).

Tablet / Tablet PC is "a notebook computer with an LCD touch-screen that can be used with a stylus to digitize handwriting. Tablet PC's use digital ink technology" (BusinessDictionary.com, n.d.).

User is an entity that has authority to use an application, equipment, facility, process, or system, or one who consumes or employs a good or service to obtain a benefit or to solve a problem, and who may or may not be the actual purchaser of the item (BusinessDictionary.com, n.d.).

Web 2.0, according to Tim O'Reilly (2007), is a concept that "doesn't have a hard boundary, but rather, a gravitational core" (p. 18). O'Reilly (2007) asserts that this core is embodied by companies that demonstrate competencies including:

- services, not packaged software, with cost-effective scalability,
- control over unique, hard-to-recreate data sources that get richer as more people use them,
- trusting users as co-developers,
- harnessing collective intelligence,
- leveraging the long tail through customer self-service,

- software above the level of a single device,
- lightweight user interfaces, development models, AND business models. (p. 37)

Web applications include any software that is designed for use directly over an internet-connected browser as opposed to one that is not installed directly on local hardware.

Research Parameters

Designed as an annotated bibliography, this study uses a systematic approach, integrating methods akin to literature review, to identify references and "share with the reader the results of other studies that are closely related to the one being undertaken" (Creswell, 2009, p. 25). This section describes the following components: (a) search strategy, (b) search patterns, (c) the documentation approach, (d) evaluation criteria, and (e) the reading and organization plan.

Search Strategy

The search for relevant literature is conducted using search engines including the University of Oregon's Library OneSearch aggregator, Google Scholar, Google Books, CrossRef, Pubget, CiteSeer, and Institute of Electrical and Electronics Engineers Xplore Digital Library. Once a target document is identified and sourced, then a copy of the document is collected locally and tagged in the filename in an AUTHOR_TITLE_ORG.FILENAME format. Each document is skimmed, including the References section for identification of related works and possible inclusion in this research.

Following Creswell's (2009) guidance, content is selected through key word identification using online search engines for primary location and retrieval of content. Initial key words are derived from searching the exact phrase *mobile device usage influence on desktop systems* and subsequent key words are refined from the results of the initial search. As the research progresses, the topic is dynamically refined with initial searches centering around the following key word clusters:

- mobile technology, **mobile computing**, mobile services, smartphones, tablets post PC's devices (PPD's)

- **influence on desktop platform**, personal computers, desktop applications, workflow continuity
- phone interfaces, **mobile interfaces**, mobile Web, Web 2.0, mobile OS, iOS, Android
- perceptions, **customer satisfaction**, design decisions and customer expectations
- engineering myopia –vision, specialization, single-mindedness
- user requirements, design requirements, design decisions, **user expectations**
- technological paradigms, innovation methods

As each reference is selected, this group is filtered to retain those items central to the topic with the focus of those that fit a literature selection plan below. Summaries of each relevant selection identifying important concepts, major themes, and a suggestion of how it fits in the Annotated Bibliography (Creswell, 2009, p. 30) are captured in a Zotero Notes field.

Search Patterns

Searches are conducted using key terms and phrases and validated research articles are then retained. The bibliographic reference list of each relevant article is gleaned for additional reference sources or possible alternate keywords or phrases. Each evaluated article is tagged as it is identified to add to, extend, or replicate research already completed (Creswell, 2009, p. 34). The validated articles are grouped into three discrete aspects of the mobile computing environment: (a) mobile tasks, (b) mobile context, and (c) mobile technology (Yuan & Zheng, 2005). Some works may cover more than one of the above segments, but weighting is given to the area most prominently covered in the article. References directly related to the influences on mobile device users or the impact of those expectations on desktop software is given preference and greater latitude in the cited date range.

This search process is repeated until discovery of additional qualifying results yields only previously discovered qualifying sources.

Documentation Approach

Smith (2008, p. 3) recommends recording the following documentation approach for each article:

- citation
- main point
- definitions, key terms
- kind of reference—essay, synthesis of literature, study
- theoretical framework
- methodology – quantitative, qualitative, basic profile of study
- key findings & position - note any important statistics
- links to other articles
- questions that come up as you read
- quotations you might use – only brief ones

Google Scholar and UO Library Search provide the initial results linking to citation and abstract information in the corresponding source repository (i.e. ACM Portal, ACM-Digital Library, EBSCO Host, ELSEVIER, ERIC, Linkhub, SelectedWorks, Worldcat, etc.) Using the Mozilla Firefox add-on Zotero, the bibliographic details are captured for further reading and exploration. During import, citations are manually tagged with key words, and originating source to facilitate future recall; including tags for the selections included within this annotated bibliography and reference list. Also included with each reference in Zotero is a Zotero *Notes* entry used to capture any elements of the documentation approach identified by Smith in 2008.

All retained content is then synchronized with the Zotero Server, which provides remote storage facilitating access from any web-accessible locations.

Evaluation Criteria

All collected items are first selected for credibility and relevancy and per Creswell's (2009, p. 33) recommendation, are then reviewed using the following priorities with preferences given in this order:

- syntheses and summaries on topic
- journal articles (current, local authors)
- books related to topic
- conference papers
- dissertation abstracts
- web references

Selection preference is also given to references published between 2007 and 2011.

Bell and Smith (2009) enumerate evaluation criteria to vet the credibility of selected references—these criteria include "authority, objectivity, quality, coverage, and currency" (Bell & Smith, 2009). Bell and Smith (2009) address authority as reflected by the number of citations associated with this author or their previous works, their credentials in the document, the publishing source, and possible collaborations with others. The authors' objectivity may be explicitly stated though include observation through more subtle criteria including explicit bias presented, affiliations and the general appearance and construction of the article. Quality further explores the construction of the article, ensuring that it makes accurate use of formatting, grammar, and graphics. Coverage speaks to the context of a work with respect to extant literature or other research materials discovered in the search. This author evaluates relevancy with respect

to the time of publication in conjunction with the 2007 release of the iPhone (West & Mace, 2010, p. 7).

Reading and Organization Plan

Reading plan. This reading plan is designed to organize the in-depth reading of all selected information and ensure a consistent perspective and treatment of those items. Designed to analyze the selected references for content relevant to the research questions and goals (Busch et al., 2011), this plan describes a step-by-step coding process.

Each reference selection is initially skimmed to establish relevance to the research topic. Each is verified to map to one of the research questions or supports research of the characteristics that influence user expectations. Consideration is given to sources that meet the previously cited Evaluation Criteria (Bell & Smith, 2009).

Once validity of the source is established, the abstract and citation are captured in Zotero as described in the Documentation approach section with care to record reproducible sourcing of the reference items. An entry is also recorded in this research under the corresponding citation.

Entries are individually evaluated and mapped into coding scheme according to the conceptual analysis process described by Busch et al. (2011). The conceptual analysis process provides a vehicle to analyze text-based content and limit problems of reliability and validity using a systematic methodology. By selecting a concept and examining target literature in relation to that concept, "the analysis quantifying and tallying its presence" (Busch et al., 2011) creates a "somewhat subjective system" for evaluation. Busch et al. (2011) identify the specific steps of conceptual analysis process as:

- *Decide the level of analysis*. In this study, coding emphasis is on words and phrases that relate to the research topic, for example *mobile computing*, *smartphones and tablets*,

influence on desktop platform, and *mobile interfaces* are used to initially cull the results to topics related to user expectations and the mobile user experience. Much like the development of the key word selections, the level of analysis is one of progressive refinement.

- *Decide how many concepts to code for*. In this study, three key concepts are coded. These three concepts relate to the research questions and address: (a) mobile tasks preferred by users, (b) mobile contexts preferred by users, and (c) mobile technology features preferred by users (Yuan & Zheng, 2005) (see Table 1).

Table 1

Research questions mapped to conceptual analysis codes

Question	
Concept	**Key words / Phrases OR Description**
When using smartphones and tablets, what characteristics of *mobile tasks* (Yuan & Zheng, 2005) preferred by users?	
mobile task	phone interfaces, mobile interfaces, mobile Web, Web 2.0, mobile OS, iOS, Android, Applications
When using smartphones and tablets, how does the *mobile context* (Yuan & Zheng, 2005) influence user preferences?	
mobile context	technological paradigms, innovation methods, **customer satisfaction**, design decisions and customer expectations
When using smartphones and tablets, what features of the *mobile technology* (Yuan & Zheng, 2005) do users prefer?	
mobile technology	mobile technology, **mobile computing**, mobile services, smartphones, tablets, post PC's devices (PPD's)

- *Decide whether to code for existence or frequency of a concept*. In this study, literature is coded for the existence of thematic elements that relate to the research questions. Emergent topics are reclassified as best-fit into the above codes or disregarded from further consideration.

- *Decide on how you will distinguish rules for coding*. In this study, the rules for coding include more than a simple key word match. Topics are coded according to the implicit meaning of the text and the concept being addressed in the research. Sections may share more than one code.
- *Decide what to do with irrelevant information*. In this review elements of the literature not coded include predictive assumptions, case studies, nor trending content.
- *Code the texts*. The deep-reading of each sourced document entails the identification and coding of each conceptual element. The detail is captured in the Zotero record. The primary thematic categorization is recorded in bold text for easy future identification.
- *Analyze your results*. Once coding is complete, each entry in the Annotated Bibliography is analyzed using the criteria set forth by Busch et al. (2011) for validity using the conceptual analysis process. Organized by the identified major thematic elements, each work is located according to the organizational plan below.

Organizational plan. Structured as a thematic review, the literature selections in this Annotated Bibliography are "organized around a topic or issue" (University of North Carolina, n.d.). Based on the sub-questions topics, each bibliography entry is related into one of three themes. Theme 1 covers research topics on the tasks that mobile users perform and how these factors influence preferences (Yuan & Zheng, 2005). Smart phones and tablets have found their way into so many dimensions of daily life that their presence has modified how many tasks are completed (Gong & Tarasewich, 2004, p. 3751).

The second theme examines research regarding the environmental factors that frame the context of mobile device usage. Mobile computing capabilities have transformed where tasks are performed (Yuan & Zheng, 2005). For example, instead of waiting to return to the office and

research details for a vacation, people are able to access the information they need regardless of their location or social setting (Yuan & Zheng, 2005). In addition to the physical environment, the context of usage includes the ecosystem the mobile device operates within including their user interface, connectivity providers and application offering and delivery system (Basole, 2011).

The third theme addresses the sub-questions about user preferences for technical features in mobile devices (Yuan & Zheng, 2005) and includes research that presents (a) compelling technical features for mobile device users (Ackerman & Guizzo, 2011), (b) technical features are unique to mobile computing (Baudisch & Holz, 2010), and (c) influencing technical capabilities that drive user preference of mobile devices (Feijoo, Pascu, Misuraca, & Lusoli, 2009).

Organization of this bibliography aligns selected references to themes embedded in the sub-questions: (a) the influences of smartphone and tablet usage on mobile tasks (Yuan & Zheng, 2005); (b) environmental use factors that frame the mobile context for the use of technology and tasks being completed (Yuan & Zheng, 2005); and (c) identification of technical features that contribute to user preferences (Yuan & Zheng, 2005).

Annotated Bibliography

The purpose of this study is to identify popular features of mobile computing environments, in order to examine the impact of user expectations on desktop computing software development. This annotated bibliography is organized around a set of themes that explore user preferences of mobile computing devices in order to extrapolate how these preferences might impact user expectations of desktop computing software development. The ideas are selected from the references, and presented in relation to research goals articulated within three themes. The three themes are: (a) user preferences of smartphone and tablet usage in relation to mobile tasks (Yuan & Zheng, 2005), (b) environmental use factors that frame the mobile context for the use of technology and tasks being completed (Yuan & Zheng, 2005), and (c) user preferences of mobile device technical features (Yuan & Zheng, 2005).

Each annotation consists of three parts: (a) an excerpt from the abstract published within the reference; (b) a description of how the credibility of the reference is determined; and (c) a summary of the key concepts within the reference as used in this study.

Theme 1: User Preferences of Smartphone and Tablet Usage in Relation to Mobile Tasks

Basole, R. C. (2008). Enterprise mobility: Researching a new paradigm. *Information, Knowledge, Systems Management, 7*(1), 1-7.

Abstract. The proliferation of mobile information and communication technologies has led to a profound change in the way people work, communicate, and collaborate and conduct business. However, businesses today are just beginning to recognize the importance and potentially transformative impact of enterprise mobility. While the concept of enterprise mobility continues to emerge in the management and technology

literatures, it is still not well understood (Basole, 2008, p. 1). With perspectives from leading scholars and practitioners on the value and transformative impact of enterprise mobility on work, technology, and organizations, this article references a series of other works and aims to extend theoretical and practical understanding of enterprise mobility. Mobile information communication technology provides a means for the worker to "access and utilize work-critical data and information wherever and whenever they need it" (Basole, 2008, p. 6).

Credibility. Dr. Rahul Basole is a Research Scientist and the Director of Technology Strategy at the Tennenbaum Institute at Georgia Technology. In his current role, Dr. Basole directs research on the complexity of value networks and eco-systems with a focus on the mobile telecommunications domain.

Summary. This article identifies three key areas of enterprise mobility research: (a) the changing nature of work, work practices and the work environment; (b) critical enablers of enterprise mobility; and (c) strategic considerations for enterprise mobility tasks. Basole observes "social and technical systems are highly interdependent and must be jointly optimized to create effective mobile work environments" where those relationships were distinct. He identifies issues of user-perceived technological maturity, basic communications infrastructure and the mobile technology and their impact on job performance and personal life. Mobile applications are considered one of the key enablers of enterprise mobility. They emphasize the importance of crafting true mobile solutions to solve business problems, not simply extend existing business applications.

Caus, T., Christmann, S., & Hagenhoff, S. (2010). Empirical assessment on user acceptance of mobile applications deployment. *2010 Ninth International Conference on Mobile*

Business and 2010 Ninth Global Mobility Roundtable (pp. 243-250). Presented at the 2010 Ninth International Conference on Mobile Business and 2010 Ninth Global Mobility Roundtable, Athens, Greece: IEEE. doi:10.1109/ICMB-GMR.2010.14

Abstract. Caus et al. (2010) introduced their study as an empirical assessment on user acceptance of mobile application distribution and installation. This conference paper focused on observations from a deployment of specific Java-software on various mobile device configurations. The development, distribution and installation of software on end-user devices is a complex problem due to the very heterogeneous landscape of mobile devices (especially with regard to software platforms, operational concepts and functionality), and the wide range of technical expertise on the side of the end user. The study was carried out on a mobile application which users installed on their own mobile phones via Bluetooth.

Credibility. Caus, Christmann, and Hagenhoff from the Department of Information Systems and E-Business at Georg August University of Gottingen, Germany study the topic of social and mobile service computing; their goal is to simplify the interaction for users. Their work has been published by the IEEE Computer Society and they have presented at the International Conference on Mobile Business multiple years.

Summary. This research identifies two key considerations influencing mobile task acceptance: (a) access to the applications through multiple forms of network infrastructure distribution mechanisms, and (b) the technical readiness of the user when they have an ad-hoc need to access a new application (Caus et al., 2010, p. 249). The authors suggest that applications distributed with the purchase of a platform are good, but users desire to be able to extend and enhance their experience.

Gebauer, J. (2008). User requirements of mobile technology: a summary of research results. *Information Systems and e-Business Management, 6,* 361-384.

Abstract. As advanced mobile technology becomes more widespread, the impacts on professional environments and on the personal lives of individual users continue to increase. Devices, such as smart cell phones, personal digital assistants (PDAs), and laptop computers can free their owners of the need to remain close to a wired information system infrastructure that is provided in a stationary office environment, and provide the opportunity to perform tasks in a wide variety of use contexts. With changes in use context, however, come changes in requirements, such as the need to limit weight and size of a device. In order to achieve success in the form of adoption, use, and positive impacts on user performance, a thorough understanding is needed about the functional and non-functional technology requirements of mobile professionals. In this paper, we summarize the results of a series of research studies that we conducted to explore the technology requirements of mobile professionals. The research studies included a content analysis of online user reviews, two empirical surveys, and a series of user interviews.

Summary. The research findings in this study indicate that (a) user-perceived technology maturity is a critical factor to explain and predict the use of mobile technology by mobile professionals; (b) mobile technology needs to be available in a broad variety of use-situations; (c) users require basic communication and productivity-related functionality, in particular to support non-routine and supervisory task profiles; and (d) mobile technology can have considerable impacts on the job performance and on the personal lives of its users.

Credibility. In 2008, Dr. Judith Gebauer is an associate professor in the department of Information Systems and Operations Management at the University of North Carolina Wilmington. Previously, Dr. Gebauer was an assistant professor in the Business Administration College of Business at University of Illinois at Urbana-Champaign and a research fellow lecturing at University of California, Berkeley. Her research is focused on business information technology and information systems with special focus on task-technology fit of mobile information systems.

Lee, A. (2009). Mobile web widgets: Enabler of enterprise mobility work. *2nd Workshop on Mashups, Enterprise Mashups and Lightweight Composition on the Web*. Presented at the MEM 2009, Spain.

Abstract. Increasingly, many smartphones (i.e., Apple iPhone, Google Android, PalmPre, Blackberry Storm and Bold, and Nokia S60) today are equipped with standards-based Web browsers that facilitate access to and interaction with the Web. In some cases the smartphones add a web application runtime environment that runs widgets that serve as front ends to Web 2.0 services or Internet content. These widgets can have access to platform resources and capabilities that enable more personal and context-aware applications. Platform service access and mobile work context provide two key differentiators of mobile Web widgets from their desktop counterparts. As such, the mashups enabled by mobile Web widgets have the potential to empower large numbers of smartphones with capabilities and services that are hitherto limited by heterogeneity of device operating systems.

Credibility. Alison Lee is a mobile web experience researcher in Palo Alto, CA at the Nokia Research Center. Her research spans a number of areas related to HCI and CSCW

(computer-supported cooperative work). She has worked on accessibility, eCommerce and eBusiness, information access, management, and use, multimedia, multimodal interaction, social computing, UI toolkits, and the Web.

Summary. This research demonstrated the value in use of mobile web widgets to present a uniform experience between mobile and desktop systems for everything from development and prototyping through piloting and deployment of applied mashups. Calendar synchronization was identified by Lee's interviewees as one of the dominant applications used. Research studies of the mobile context reveal "differences in how work is done compared to the desktop context and which applications are used compared to PCs or laptops. For example, the unpredictability of information access and unfamiliarity with mobile environment pose unique difficulties" (p. 1) on the computing applications.

Mascolo, C. (2010). The power of mobile computing in a social era. *Internet Computing, IEEE*, *14*(6), 76-79.

Abstract. The most powerful trend in mobile computing is that of increased online social activity. To meet users' future expectations, mobile computing researchers must consider current limitations and identify upcoming challenges. Here the author identifies the challenges imposed as well as the opportunities, which this reality brings.

Credibility. Dr. Cecilia Mascolo has a PhD in computer science from University of Bologna and is a reader in mobile systems in the Computer Laboratory at the University of Cambridge.

Summary. This article addresses the influence of social media on mobile devices. Mascolo observes the number of mobile phone users is already significantly higher than

desktop users citing a “much more dynamic connectivity patterns” presenting a “much more dynamic load on systems handling content for social networking sites” (p. 76). Relevantly, it recognizes that “users expect the same level of service and performance on their cell phone as they experience from their desktops” (p. 77) and that “current devices’ limitations are impacting the way individuals use devices” (p. 77). The ubiquitous and pervasive nature of mobile devices is leveraged by the ability to draw on the devices’ sensor systems, capturing details including images, locations, temperature and interaction patterns—something most desktop systems do not provide. “Low latency, high responsiveness, ease of interaction, and always-on connectivity are implicit user requirements” (p. 77) for the mobile user.

Mutchler, L. A., Shim, J. P., & Ormond, D. (2011). Exploratory study on users’ behavior: Smartphone usage. *Proceedings of the Seventeenth Americas Conference on Information Systems* (p. 10). Presented at the Americas Conference on Information Systems (AMCIS) 2011, Detroit, Michigan: AIS Electronic Library (AISeL). Retrieved from http://aisel.aisnet.org/amcis2011_submissions/418

Abstract. Communication technologies have advanced at unprecedented rates each year. Together with these advances in technology, the Smartphone has emerged and has experienced a dramatic increase in worldwide use. In fact, Smartphones have become the “all-in-one” device or the “Swiss army knife” as they provide mobile access to voice, video, data, and image communications. The present study represents a research in progress to better understand the Smartphone use through an exploration of motivational factors. The findings of this study should serve to inform IS professionals, mobile

application providers, and mobile device service providers with their future endeavors in the area of mobile device management and service.

Credibility. Leigh Mutchler is a doctoral candidate at Mississippi State University, and Dustin Ormond is a computer support representative and research assistant at Brigham Young University. They co-authored this work together with Dr. J. P. Shim, professor emeritus of Business Information Systems (2011) at Robinson College of Business Georgia State University. Shim also held the Larry and Tonya Favreau Notable Scholar in 2010. Dr. Shim has co-authored five books and published over 60 journal articles and 100 conference papers in his field.

Summary. Focus groups identified communication, education, and entertainment as the primary tasks of smartphone users. Through a mixed method study they identified the following predictors of mobile technology usage, satisfaction, and performance: (a) ease-of-use, (b) portability, (c) communications, and (d) productivity related functionality (Mutchler, Shim & Ormond, 2011, p. 5) also referenced Gebauer (2008) they added factors of (e) convenience, (f) timeliness, and (g) flexibility. The factor of *convenience* figures at or near the top of each smartphone task category as a compelling predictor. Common to all category results, smartphones users identified them as addicting, distracting, and suffered from battery life concerns (Mutchler et al., 2011, p. 6).

Zhou, T. (2011). An empirical examination of users' post-adoption behaviour of mobile services. *Behaviour & Information Technology*, *30*(2), 241-250. doi:10.1080/0144929X.2010.543702

Abstract. Extant research has focused on the initial adoption and usage of mobile services and paid little attention to the post-adoption and continuance usage. However, unless users continue using mobile services, service providers cannot achieve success. This research develops a mobile post-adoption model where the behavior includes three variables: continuance intention, recommendation and complaint. The results indicated that expectation confirmation, perceived ease of use, perceived usefulness and usage cost significantly affect users' satisfaction, further determining their post-adoption behavior. In addition, perceived usefulness has a direct effect on the continuance intention.

Credibility. Zhou is from the Department of Management Engineering, School of Management, Hangzhou Dianzi University, Hangzhou, People's Republic of China.

Summary. This study explores the impact of infrastructure and how it relates to positive relationship with user satisfaction. Identifies current mobile internet usage accounts for 66% of the internet population. Research results indicate that *expectation confirmation*, meaning users get what they were expecting in the user experience and quality of mobile service, and *perceived ease of use* both have significant effects on *perceived usefulness* and these three factors determine user satisfaction. Citing that "mobile users always expect to acquire impressive usage experiences and high quality services" (p. 246) there is still an expectation that service providers should present a well-designed interface to users. This conclusion is drawn from Zhou's research on the significant contribution of perceived ease of use on satisfaction. Mobile users "expect mobile services to improve

their working and living performance and effectiveness" (p. 247). Concluding, Zhou (2011) cites,

> Perceived usefulness is also found to be a significant factor of satisfaction and continuance intention. Considering its effect during both initial adoption and post-adoption phase, mobile service providers need to attach great importance to the perceived usefulness. They can optimize their interface design to decrease users' operation difficulty and increase their perceived usefulness. (p. 248)

Theme 2: Environmental Use Factors that Frame the Mobile Context

Babb Jr, J. S., & Abdullat, A. (2011). The need for mobile application development in IS curricula: An innovation and disruptive technologies perspective. *2011 ISECON Proceedings* (Vol. 28, p. 14). Presented at the Information Systems Educators Conference, Wilmington North Carolina, USA: EDSIG (Education Special Interest Group of the AITP). Retrieved from www.aitp-edsig.org

Abstract. Disruptive technologies, such as mobile applications development, will always present a dilemma for Information Systems educators as dominant paradigms in our environment will tend to favor the existing sustaining technologies that we have become known for in our discipline. In light of this friction, we share our approach in investigating and designing a mobile application development which centers on student-faculty partnerships. We discuss a mobile application prototyping strategy and process which has allowed first-hand exploration of the current generation of mobile devices, and associated operating systems (Android and iOS). The nature of application development for these current-generation devices is discussed. These strategies and the thinking surrounding them are influenced by theories on disruptive technologies and innovation.

Credibility. Jeffry S. Babb, is an Assistant Professor at West Texas A&M University with a doctoral degree in information systems from Virginia Commonwealth University - School of Business in 2009. Amjad Abdullat holds the chair in the Computer Information Systems Department at West Texas A&M University.

Summary. As Babb and Abdullat (2011) introduce the characteristics of disruptive technologies, they observe this distinctive characteristic among the field of succeeding smartphone capabilities, “that they foster and flourish a software application *ecosystem*,

typically characterized by *apps* and *app stores"* (p. 5). The authors note the "always-on access to the Internet and the World Wide Web, access to a software shopping, purchasing, distribution, and maintenance infrastructure commonly and colloquially known as application stores, or *app stores.*" They state these devices "are more hand-held computers than mobile phones" (p. 5). This article also includes a table of "Top Strategic Technologies for 2011 and Beyond" highlighting key technologies and their relevance to the current generation of mobile computing (see Table 3).

Table 2

Top Strategic Technologies for 2011 and Beyond (Babb & Abdullat, 2011, p. 11)

Strategic Technology	**Relevance to Current Generation Mobile Computing**
Cloud Computing	This is no longer simply a concern for Enterprise computing, as evidenced by services like *Dropbox*, *MediaFire*, and *Hulu*
Mobile and Tablet Applications	By and large, it is the application ecosystem available for these devices that constitutes the appeal of these mobile platforms
Social Networking	It can be argued that social networking has reinvigorated the web and computing as all aspects, both private and corporate, of life are assimilated into social networks. Mobile devices are a popular access node.
Video	The capture and sharing of this data is also key to the demand for mobile devices
Next-Generation Analytics	Mobile devices, particularly location information, represent important and valuable metrics
Social Analytics	Brining a social network aspect into CRM and market development into the analytics picture. This approach is evident in Social Network Analysis
Context-Aware Computing	It is quite clear that mobile computing is the primary enabler of this concept. The latest generation of mobile devices allows for a full who, what, where, and when picture.
Ubiquitous computing	This is also possible largely through the mobile device and its ability to allow a user to never lose contact of the computing environment.

Each of these strategic technologies carry implications not just for mobile computing but also for the desktop environment. While some are well developed operating models, like cloud computing and video playback), and are already well established as a background

part of our collective web experience, others carry potential for mobile users when returning to the desktop space. Ubiquitous computing has afforded the social networking community opportunity to step well outside its initial parameters of several applications and coupled with context awareness presents scenarios that the desktop cannot inherently address. The mobile computing context also introduced the concept of application stores, making thousands of new software applications available to the end user through a convenient application portal.

Basole, R. C., & Karla, J. (2011). On the evolution of mobile platform ecosystem structure and strategy. *Business & Information Systems Engineering*, *3*(5), 313-322. doi:10.1007/s12599-011-0174-4

Abstract. Platforms have become a foundational element of many technology industries. Platforms not only enable new products and services but have also been shown to influence strategies, shape business models, and even transform entire industries. Platforms play a particularly important role in the mobile ecosystem. The success of smartphones has led to an intense battle of mobile platforms, each looking for ways to become the system of choice for mobile device manufacturers, mobile network operators, and mobile application developers. Drawing on theories of platform markets, strategic networks, and business ecosystems, this paper uses a visualization approach to study the evolving global inter-firm structure and examines strategies used in the mobile platform ecosystem over the past five years. We identify important differences between mobile platform strategies and discuss their implications for both mobile ecosystem participants and the future of the app economy.

Credibility. Dr. Rahul Basole is a Research Scientist and the Director of Technology Strategy at the Tennenbaum Institute at Georgia Technology. In his current role, Dr. Basole directs research on the complexity of value networks and eco-systems with a focus on the mobile telecommunications domain. Dr, Jürgen Karla is a Privatdozent, Senior Lecturer and Senior Researcher at RWTH Aachen University, Aachen, Germany. Researching in the field of Business Administration - Management Information Systems including Web 2.0, Social Media, Enterprise 2.0, Media Management, Mobile Business.

Summary. Basole and Karla's work reviews research using a visualization approach to provide a 5-year look at the evolving structure and strategies used in the mobile platform ecosystem. They categorize this changing mobile ecosystem into four segments: (a) mobile device manufacturers, (b) mobile network operators, (c) mobile application developers, and (d) mobile platform providers. This research identifies the popularity of mobile applications and the idea of an *app store* citing "the data presents only a proxy for the preferences and behavior of the mobile application developers" (p. 320). Consumers and corporations recognize this preference for access to applications. Predicated upon a supply and demand model the once tightly controlled device application market has become an *app economy* with full industry built up around this marketplace. The advent of mobile platforms eliminated what was once a very limited point of access to the customers opening the door to the world buying and selling applications to personalize the mobile devices.

Baudisch, P., & Holz, C. (2010). My new PC is a mobile phone. *XRDS, 16*(4), 36-41. doi:10.1145/1764848.1764857

Abstract. The most popular computational device in the world today is neither a desktop computer nor a netbook nor a hundred-dollar laptop—it is the mobile phone. This review of techniques and capabilities being developed to better suit what we think of as the new smallness.

Credibility. Dr. Patrick Baudisch is a professor in Computer Science at Hasso Plattener Institute in Potsdam, Germany and chair of the Human-Computer Interaction Lab. His background includes work with Microsoft Research and Xerox PARC. Christian Holz is a PhD student in of the Human-Computer Interaction at Hasso Plattener Institute in Potsdam, Germany and previously was a research scholar at Columbia University.

Summary. Baudisch and Holz's work identifies several contextual factors of the mobile environment that make the mobile device market so compelling; (a) it keeps people connected, (b) it is widely available, and (c) it has low production costs. The mobile environment supports interactive web browsing, viewing and editing of documents, spread sheets, images and more. They assert the "role of mobile devices as desktop replacements and as terminals" require new categories of mobile applications that "will allow users to not only view the data, but also analyze and manipulate it" (p. 37). Much of the article reflects the furtherance of touch-based input to control the device, where direct manipulation using touchscreens allow more complex and interactive applications. Desktop devices generally do not have accommodations for this type of input.

Blackwell, A. F., & Fincher, S. (2010). PUX: Patterns of user experience. *Interactions*, 17(27). doi:10.1145/1699775.1699782

Abstract. Blackwell's PUX: Patterns of User Experience asserts that there is a fundamentally flawed perspective on how the user experience is commonly described by software developers. Stating, "*Traditional* software patterns are [not] concerned with the user experience, but mostly with the experience of the programmers" (p. 1) he implies a there is a better way to describe the experience. This research seeks to establish "a pattern language of *user experience* design rather than a pattern language of *user interface* design" (p. 1). Rather than attempting to present empirical research to validate a premise, Blackwell and Fincher explore what would a user experience pattern look like and consider user experiences as representational systems used to help define software development.

Credibility. Dr. Blackwell is Reader of Interdisciplinary Design at Computer Laboratory of Cambridge University. Dr. Sally Fincher is professor of Computing Education and the head of the Computing Education Research Group at the University of Kent with a particular focus on human-computer interactions. Publishing since 1993 they have a history of co-authored peer-reviewed works. Both are involved at Crucible (the Cambridge network for research in interdisciplinary design), where Blackwell is co-director.

Summary. In pursuit of defining the components of a user experience pattern language, Blackwell and Fincher identify concepts that describe the environmental context of the user experience. Concluding, they identify a key insight: Considering the "abstract experience of representational systems is to recognize that the users of systems are

ultimately concerned with navigating and configuring an information structure, just as users of a building are ultimately concerned with navigating and configuring the structure of space" (Blackwell & Fincher, 2010, p. 6). This work is relevant when considering environmental use factors that frame the mobile context of the user experience in that it provides a perspective to consider the temporal, structural, and configurable features of mobile technology usage. Temporal factors (factors that are experienced as they change over time) of mobile usage present information systems challenges that stationary systems do not typically encounter. In a mobile scenario, a user may be in car one time and at a restaurant at another—each time accessing the same information system. Structural factors speak to a users' ability see dependencies in a system. Configurable features allow users to customize the presentation of their experience at will.

Brugnoli, M. C., Hamard, J., & Rukzio, E. (2005). User expectations for simple mobile ubiquitous computing environments. *Mobile Commerce and Services, 2005. The Second IEEE International Workshop on* (pp. 2-10). Presented at the WMCS '05, Munich: IEEE. doi:10.1109/WMCS.2005.27

Abstract. In mobile ubiquitous computing environments users will be able to interact with different devices, providing them with many services. The technological heterogeneity of such an environment is expected to increase the overall system complexity. Flexibility and adaptability are thus key issues to cope with this complexity.

Credibility. Maria Cristina Brugnoli is a human factors expert and R&D manager near Rome, Italy. John Hamard graduated in 2000 from the Paris V University with a Master Degree in Ergonomics. Dr. Enrico Rukzio is an assistant professor and chair holder at University of Duisburg-Essen and lecturer at Lancaster University with a focus

on human-computer-interaction and pervasive computing. He has published over 60 internationally peer-reviewed publications including conference presentations at CHI, UIST, Ubicomp and Mobile HCI. He has written for IEEE Pervasive Computing journal and holds two patents.

Summary. Results of their research on mobile ubiquitous computing environments, while predating the current revolution in mobile computing platforms, yielded data relevant to this study. Findings identified "cross-cutting needs relevant to all tools in the new technological world (applications, connections, devices)" (Brugnoli, Hamard, & Rukzio, 2005, p. 8) focusing around (a) data, (b) equipment and devices, (c) networks, and (d) software systems. Also relevant are findings on the importance of location based services to users assisting in everything from parking location to GPS services. The research cites the importance of devices to offer a *sense of presence* wherein the user can customize their experience to provide a familiar, tangible, and comforting environment highlighting the value of a customizable platform.

Herold, D. K. (2010). Imperfect use? ICT provisions and human decisions: An introduction to the special issue on ICT adoption and user choices. *The Information Society*, *26*(4), 243-246. doi:10.1080/01972243.2010.489497

Abstract. Information and communication technologies (ICTs) have increasingly become an integral part of society, enhancing, changing, supporting, and complicating human lives. Although the disregard of technology inventors and designers for the users of ICTs has resulted in disjunctures between ICTs and users, users have refused to become mere agents of the designers. Individual users have developed their own uses of ICTs based on the complex webs of relations and meanings in which they function as

social actors. Instead of adjusting these webs to new ICTs, they have fit the ICTs into their preexisting social webs, often resulting in imaginative and creative uses for new technologies, not envisaged by the original designers. Accordingly, users should be given precedence over ICTs, and studies should focus less on creative uses of given technologies and more on an appropriate design of ICTs that can be integrated into human lives.

Credibility. Herold is a lecturer with the Department of Applied Social Sciences at Hong Kong Polytechnic University, Kowloon, Hong Kong and was a lecturer at Tsinghua University. ***The Information Society*** is an international multidisciplinary journal intended to answer questions about the Information Age with a particular focus of papers that analyze information policy issues affecting society from an international perspective.

Summary. Users of mobile technologies develop their own uses of ICT instead of what the developer may have envisioned. This is so because, as Herold notes "the adoption of a form of ICT does not always produce the anticipated results, but, rather, it can lead to problems and individual adaptations" (p. 244). The work habits and the individual's focus of attention become part of the overall context a mobile device is used within, rather than using the device to minimize interruptions to user's routines. The ubiquitous interactions of humans with these mobile devices create a sense of constant availability. The device is in control of the user rather than the user controlling the device. Herold demonstrates this premise through the example of custom notifications, a feature that enables users to configure notifications based on the originator of the notifications. One example is the use of custom ring tones to identify specific callers so that other callers can be temporarily disregarded.

Koivumäki, T., Ristola, A., & Kesti, M. (2008). The effects of information quality of mobile information services on user satisfaction and service acceptance–empirical evidence from Finland. *Behaviour & Information Technology, 27*(5), 375-385. doi:10.1080/01449290601177003

Abstract. Mobile services are steadily gaining greater foothold in everyday life, both in leisure and business. Framed in 2006, this research recognizes a real mobile services breakthrough, other than voice calls and SMS, has not yet been realized. This study focuses on how different dimensions of information quality affect consumers' satisfaction towards mobile information services and eventually the acceptance of these services.

Credibility. Timo Koivumäki, Annu Ristola and Manne Kesti all from the Department of Marketing, University of Oulu, Finland and have also co-published *Factors affecting consumer choice of mobile phones: Two studies from Finland.* Koivumäki is a research professor of mobile business applications, at the VTT Technical Research Centre of Finland and the University of Oulu, Finland. His research includes consumer behavior in e-commerce, m-commerce and ubiquitous environments, e-business, m-business, mobile marketing, digital economy, information goods, user-driven open innovation, ubiquitous services, and sports marketing. He is also associate director of OASIS research lab, in the University of Oulu. Ristola and Kesti were completing masters of science in 2010.

Summary. This study focuses on how different dimensions of information quality affect consumers' satisfaction towards mobile information services and eventually the acceptance of these services. Technical limitations of mobile devices like small displays, unreliable connectivity, and fixed battery life combined with situational limitations like weather, background noise and distractions all have the potential to reduce user

satisfaction and perceived sense of information service quality. Koivumäki et al. "identify four dimensions—content, context, connection and interaction—in order to reflect the characteristics of mobile services" (p. 375). "Content quality refers to the inherent value and usefulness of the information provided by mobile services" (Huizingh 2000, p. 542). Contextuality is concerned with the milieu in which users conduct their mobile tasks, such as the degree of interaction with others (Koivumäki et al., 2008, p. 376). Further Koivumäki and team emphasize that the information must not only be relevant to the user, but delivered in a timely and appropriate amount. Observing that the connection to information must be readily available and reliable as it influences the consumer's satisfaction in both utilitarian and hedonic use contexts. Results show that "all four information quality dimensions have a statistically significant positive relationship with user satisfaction. User satisfaction in turn has a positive relationship with the intention to use a service again. Results also indicate that content is more important for users with hedonic goals" (p. 356).

Liu, Y. W. (2009, June). *The implication of open innovation and open source to mobile device manufacturers*. Massachusetts Institute of Technology.

Abstract. Mobile industry, as one of the most rapidly changing industries, is also forced to adopt the open innovation model in various forms. This study examines the open innovation model beyond software development, i.e. open innovation in hardware and embedded system development. Lessons are learned through case studies of software, hardware and embedded system related business practice. Recommendations are given to Mobile industry, specifically the cell phone handset industry accordingly.

Credibility. Yuanwen Wayne Liu is pursuing the degrees of master of science in Engineering and Management at the Massachusetts Institute of Technology. Liu already holds masters of science in Computer Science from Purdue University in 2000 and a master of science in Biochemistry from Indiana University in 1998.

Summary. This thesis details the scope of mobile market growth patterns along with the influences of the open and closed market place on the mobile computing environment. The research is relevant to this bibliography through the depiction of open and closed innovation principles which have long-term influence on a computing environment. In a closed model, an ecosystem consisting of the all elements of the phones' capability is provided from a single vendor who: (a) develops the product in house or tightly regulates, (b) controls the distribution, (c) owns the network of connectivity and (d) provides the means of content distribution. An open model defers one or more of those aspects to a non-related agent who can augment or divert offering of the original mobile service provider. The research discusses motivations for companies to pursue an open source model and through the use of case studies there is a precedent for transition to a more open environment. Mobile computing vendors each decide how they envision the future for their platforms and how they want to control the market, either (a) tight control and a cohesive user experience in a closed model or (b) less control and a potentially irregular experience in an open one. Liu believes that a transition of the mobile industry from a proprietary hardware + proprietary OS + proprietary application to a standard hardware + standard OS + standard application is at a cusp, and states "the cell phone business is increasingly becoming commodity business, any company can use the free open source

OS in its product" (p. 71). As vendors select an open or closed ecosystem for their mobile computing platform, the consumers have a choice in their mobile experience.

McDowell, M. (2008). Business mobility: A changing ecosystem. *Information Knowledge Systems Management, 7*(1/2), 25-37.

Abstract. This paper examines the evolution of the still-nascent business mobility ecosystem and its key drivers, such as consumer behavior, that shape the segment. It also explores the changing roles and relationships of the ecosystem's key players; projections for growth in business mobility; and the value or ROI of business mobility. It offers advice to businesses that are considering business mobility solutions. And it points out a number of changes that members of the business mobility ecosystem will need to make in order for business mobility to evolve to the point of fruition, where companies are willingly ready to purchase solutions as a strategic investment, and where the solutions are as solid but also as flexible and easy to buy and integrate in a heterogeneous, global market. Lastly, the paper takes a look at a few large companies that have made significant steps toward strategic and holistic adoption of business mobility.

Credibility. Mary McDowell is executive vice president in charge of Mobile Phones, responsible for the business and product development of Nokia's global mobile phone operations. She has been a member of the Nokia Leadership Team since 2004, and was appointed to her current position in July 2010. McDowell joined Nokia as Executive Vice President and General Manager of Enterprise Solutions, with responsibility for the development and manufacturing of Nokia's range of enterprise products and solutions.

Summary. This research examines the implications for businesses adopting mobile workforce solutions through smartphone technology. It presents a view of the business

environment and the motivations for business deployment support of mobile systems. McDowell relates that if businesses exclusively leverage mobile e-mail, then they fail "to realize it is only the tip of the iceberg" and that they should be "looking to mobilize other mission-critical applications such as field repair or delivery – which do have a direct and measurable ROI" (p. 27). McDowell states "users want devices that are smart, intuitive, suited to both business and personal use and look good" (p. 28). Additionally, as important as the device styling and function are, "its accessibility in the market and its ability to support a variety of applications are paramount" (p. 28). This recognizes that not all businesses and business users have the same requirements. "Corporations are heterogeneous; a holistic adaptation of business mobility will require a seamless integration of features on a single system" (p. 29). As organizations move when business value presents itself, they address mobility opportunistically rather than strategically or holistically. McDowell concludes, "moving to a holistic approach will require members of the business mobility ecosystem to show the IT managers and the business leaders measurable ROI or demonstrate real business value" (p. 36).

Pijpers, V., Gordijn, J., & Akkermans, H. (2008). Business strategy-IT alignment in a multi-actor setting (p. 1). ACM Press. doi:10.1145/1409540.1409551

Abstract. In this paper we present a framework and methodology for aligning the business strategy and IT/IS for an organization offering an e-service in a multi-organizational setting. We explore three perspectives on the e-service to be offered: 1) the business strategy perspective, in terms of the organization's strategic position; 2) the value creation perspective, in terms of a networked value constellation enabling value creation; and 3) the IT/IS perspective, in terms of an IT architecture enabling the

provision of the e-service. We explore these three perspectives and modify them, until we find a situation in which 1) the designed IT architecture enables the provision of the e-service and can be implemented in a profitable way by the networked value constellation, and 2) the enterprise under study is positioned in the networked value constellation such that the enterprise can execute its business strategy. We have tested our approach on a starting enterprise offering a mobile e-service.

Credibility. Vincent Pijpers, Jaap Gordijn, Hans Akkermans worked on this research while at Vrije Universiteit Amsterdam, The Netherlands. Pijpers is a Marketing Consultant at ClickValue. Gordijn is an associate professor at Vrije Universiteit Amsterdam. Prof. Dr. J.M. (Hans) Akkermans is on the Faculty of Sciences for the Department of Informatics Business and head of Web & Media at Vrije Universiteit Amsterdam.

Summary. This paper seeks to explore the alignment of enterprise business strategies with the required information technology necessary to deliver a comprehensive deployment of mobile technologies in a business setting. Pijpers et al. refer to this deployment environment as an *e-service* and suggest four different perspectives that must be considered:

(a) the Business Strategy perspective, which considers long term goals to create competitive advantage with the e-service;

(b) the Value Creation perspective, which considers how value is created by the e-service;

(c) the Processes perspective, which considers the activities needed to provision the e-service and thereby create value;

(d) the IT/IS perspective, which considers the IT/IS that supports or enables the processes and therefore the e-service. (p. 2)

Pijpers et al. identify there is more needed than just a device for a mobile platform to be successful in a business environment. The supporting corporate infrastructure must also be present in addition to having an established well-defined value proposition.

Ryan, C., & Gonsalves, A. (2005). The effect of context and application type on mobile usability: an empirical study. *Proceedings of the Twenty-eighth Australasian conference on Computer Science - Volume 38* (Vol. 38, pp. 115-124). Presented at the Conferences in Research and Practice in Information Technology, Newcastle, Australia: Australian Computer Society, Inc.

Abstract. This paper discusses the effect of context on mobile usability, proposes an expanded model of mobile application context, and conducts an empirical study to test a number of hypotheses concerning the use of software implementation technology and location context in mobile applications. Four different application types (PC web based, PC device based, mobile web based and mobile device based) were tested using a within-subjects repeated-measures design. The results demonstrate that by utilizing client side processing and location context, the mobile device based application is able to achieve objective performance and subjective usability measures comparable to those of the PC based versions, despite the limited input and display capabilities of the mobile device. Conversely, the mobile web based application, which was unable to take advantage of location context or client-side application code, showed the lowest quantitative performance.

Credibility. Dr. Caspar Ryan and Atish Gonsalves are both from the school of Computer Science and Information Technology at RMIT University, Melbourne, Australia. Dr. Ryan Mobile specializes in mobile object systems, mobile collaboration, wireless/pervasive computing, enterprise computing, and virtual communities. Dr. Gonsalves received his doctorate from RMIT University.

Summary. This study establishes the importance of usability in the success of mobile applications and considers the remaining challenges. Web based applications enjoy an easier development process and simpler integration with existing web applications. This affords the developer centralized deployment and maintenance, and typically embodies lower user device requirements. Mobile web applications and PC web applications may be alike in that they both render web pages in a similar manner; the most significant differences in mobile application design is screen size and a requirement for constant connection to the internet. Other challenges for the web-based designs include security, cumbersome navigation and limited client-side functionality (p. 2). For device-based applications, there is a greater disparity between mobile device based and PC device based applications. This disparity is particularly noticeable for mobile developers who are required to support a heterogeneous group of platforms—many with widely varying capabilities. Interactions between the physical environment and the user are particularly interesting in that the mobile based user is more likely to face issues around "noise, poor lighting, obstacles causing black pots, physical confinement, and impairment of dexterity due to excessive movement or other potentially hazardous operating conditions" (p. 3). Through the four software implementation types Ryan and Gonsalves considered the

impact of the run-time software environment and its correlation to the interactions between user, device and the physical environment.

Tarasewich, P., Gong, J., Nah, F. F.-H. & DeWester, D. (2008). Mobile interaction design: Integrating individual and organizational perspectives. *Information Knowledge Systems Management, 7*(1/2), 121-144.

Abstract. While mobile computing provides organizations with many information systems implementation alternatives, it is often difficult to predict the potential benefits, limitations, and problems with mobile applications. Given the inherent portability of mobile devices, many design and use issues can arise which do not exist with desktop systems. While many existing rules of thumb for design of stationary systems apply to mobile systems, many new ones emerge. Issues such as the security and privacy of information take on new dimensions, and potential conflicts can develop when a single mobile device serves both personal and business needs. This paper identifies potential issues and problems with the use of mobile information systems by examining both personal and organizational perspectives of mobile devices and applications. It provides a set of guidelines that can assist organizations in making decisions about the design and implementation of mobile technologies and applications in organizations.

Credibility. Peter Tarasewich is an Associate Professor of Information Systems and Operations Management at the Sawyer Business School, Suffolk University. He received his PhD in Operations and Information Management from the University of Connecticut, his MBA (focusing on Management Information Systems) from the University of Pittsburgh, and dual degrees in Electrical Engineering and Computer Science from Duke University. Jun Gong is a Software Engineer whose work includes improving Web search

user interfaces at Google, Inc. He recently received his PhD in Computer Science from Northeastern University, and before that his MS in Computer Science from Northeastern University and his BS in Computer Science from Fudan University, Shanghai, China. Fiona Fui-Hoon Nah is an Associate Professor of Management Information Systems (MIS) at the College of Business Administration, University of Nebraska – Lincoln. She received her PhD in MIS from the University of British Columbia, and her MS and BS (Honors) in Computer and Information Sciences from the National University of Singapore. David DeWester is a PhD student in Management Information Systems at the College of Business Administration, University of Nebraska – Lincoln. He received his BS in Mathematics from Colorado State University and his MA in Mathematics from Central Michigan University, where his thesis was nominated for Best Thesis of the Year.

Summary. When users set out to use a device for personal and business needs, security and privacy of information take on new dimensions since the two use models are not always compatible. This discrepancy exposes potential conflicts. Tarasewich et al. discuss how to obtain the "right balance of controlling and empowering employees with the appropriate level of access to organizational data, and maximizing the continuity of organizational processes and activities while managing any disruptive activities arising from the use of mobile computing in organizations" (p. 121). This sets the tone for the environmental considerations of harmonizing the world of the personal and the business for the mobile user. The objective of this paper is "to identify the potential issues and problems with mobile interface design and use in organizations" (p. 122) and to present guidelines for design and decision making for the implementation of mobile technology

and applications. Tarasewich et al. identify a set of challenges facing mobile interface designers:

> – Constantly changing context of usage, e.g., business executives who are always on the move
>
> – Limited user attention given to the device and application, e.g., using the device when walking
>
> – Mobile device user's hands are typically occupied with other physical tasks, e.g., holding a briefcase or shuffling paperwork
>
> – High mobility during tasks, as well as the need to adopt a variety of positions and postures, e.g., activities of maintenance crew
>
> – Interacting with devices while in motion (at high speed), driven by external environment, e.g., in a public transport system such as a subway or train. (p. 122)

The paper explores those challenges considering four aspects related to mobile interactions. The first is input interaction which includes a variety of traditional keyboard and mouse arrangements for mobile input, additionally identifying input features like human speech, digital photography, scanner and sensors, touch screens, and even accelerometers and GPS may serve as input methodologies. Each input type comes with pros and cons adding to the complexity of evaluating the suitability of the mechanism for a mobile form factor. Mobile output interactions are typically limited to a reduced screen area, though there are augmentations of goggles and retinal displays or other enhancements. Other outputs include auditory and tactile notifications that either widen or narrow the scope of the audience. Another major challenge for corporate adoption centers upon security, "security is one of the main obstacles in creating a mobile

workforce" (p. 126). Mobile devices are vulnerable to loss, theft and other security breaches substantially more than workplace based systems. Additionally, constant connectivity elevates the criticality secure wireless data transmission pathways. The pervasive nature of mobile based computing platforms has now drawn the attention of virus, spyware and malware developers who are seeking to exploit these devices as a portal to the corporate infrastructure. Privacy is another challenge, due to the dynamic nature of a mobile environment, and the results that mobile device users are exposed to many more risks than they would be in an office environment. Ultimately, the user must determine an acceptable "tradeoff between the pervasive availability of information and the potential loss of privacy and security" (p. 127).

Yuan, Y., & Zheng, W. (2005). From stationary work support to mobile work support : A theoretical framework. *Mobile Business* (pp. 315-321). Presented at the International Conferences Mobile Business 2005, IEEE. doi:10.1109/ICMB.2005.42

Abstract. Most existing information systems are developed to support stationary office workers. Rapid development in mobile communication provides a great potential for us to move from traditional office support to mobile work support. Despite this great potential, we still lack the theory to fully understand the nature of mobile work. Without this understanding, it will be difficult to develop efficient and effective support for mobile workers. In this paper we propose a theoretical mobile work support framework and use this framework to analyze four fundamental aspects of mobile work: mobile workers, mobile tasks, mobile context, and mobile technology. The key differences between office work support and mobile work are also highlighted.

Credibility. Dr. Yufei Yuan is a professor of Information Systems at DeGroote School of Business, McMaster University, Canada. He served as the Wayne C. Fox Chair in Business Innovation in 2002-2008 and the chair of Management Science and Systems Area in 1996-1999. Wuping Zheng is from the Michael G. DeGroote School of Business, McMaster University, Canada.

Summary. This conference paper provides a theoretical framework for comparing the differences between computing in the traditional office and the mobile work space. Yang and Zheng's framework provides the context for identification the key aspects of mobile computing as identified in this paper. Their framework includes a *who* element identifying the mobile worker as a relevant part of the mobile worker model, including a person who is wandering, traveling, visiting, or just situated in a non-traditional workspace. This bibliography focuses more upon the *what*, *where/when*, and *how* aspects of their mobile computing model. Considering the office worker and the mobile worker there are typically knowledge workers in both categories, however mobile workers also include a broad range of job categories that could include up to 78 percent of the total mobile workforce (p. 2).

Addressing the *where* and *when*, the category of mobile tasks includes "activities performed by workers to accomplish an objective" (p. 2). Task also includes the relevance of location and temporal dependency with respect to the objectives as most mobile tasks are done within a certain time frame and location. Location may dictate specific presence for a meeting or event. Multi-task handling is another key characteristic of mobile tasks users perform, further segmenting tasks into those performed outside the computer and those inside the computer. A precedence of the external tasks of operating

a computer are of most importance and those internal taking a lesser priority. Users' hands are frequently occupied in other tasks besides operating a keyboard. Users may also be involved in tasks that demand heightened visual attention for safety, thus less attention is left for the computing task at hand.

The context of the mobile framework takes into account "the circumstances in which mobile tasks are being carried out" (p. 4). Of particular note, they highlight uncertainty as "one of the most important characteristics of mobile work" in that it has less predictability through the course of a task.

Beyond context, the framework includes mobile technology considerations, including devices and the wireless infrastructure to support the mobile devices. Balancing features of size, weight, processing power, display size and memory remains a challenge compared to the desktop capabilities, but that gap is narrowing. Between the advanced cell phone network coverage and the pervasive WiFi network, mobile devices are able to derive locational information with or without GPS circuitry.

Theme 3: User Preferences of Technical Features of Mobile Devices (smartphones and tablets)

Ackerman, E., & Guizzo, E. (2011). 5 technologies that will shape the web. *IEEE Spectrum*, *48*(6), 40-45. doi:10.1109/MSPEC.2011.5779788

Abstract. Article identifies five technologies to watch including: the mobile web, ubiquitous video, everyday objects are connected to the internet, web data becomes profuse and available, voice and gestures change human-computer interaction.

Credibility. Elise Ackerman is a contributor to the IEEE Spectrum and Forbes.com and holds the title of Mistress of the Cosmic Word at Twilio, Inc. Her background includes

nine years as a technology writer including the San Jose Mercury news. Erico Guizzo is the Senior Associate Robotics Editor at the IEEE Spectrum. *IEEE Spectrum Magazine,* explores the development, applications and implications of new technologies. It anticipates trends in engineering, science, and technology, and provides a forum for understanding, discussion and leadership in these areas. This article is part of a special report focusing on the social web.

Summary. Two of the five technology selections are directly related to the research of this annotated bibliography. In the topic, The Mobile Web Will Be a Smarter Web, the author observes "mobile devices are becoming the favored portal to their online social lives" (Ackerman & Guizzo, 2011, p. 42). Citing "more than 250 million users access Facebook on their mobile devices, and 40 percent of all tweets come from mobile platforms" (p. 42) indicating substantial margin using their smartphones to post. The other relevant matter discussed in this section is the power of context. "Most of the time when you use your phone, you're immersed in a specific context: There's the location, the day and time, what you're doing there, what is nearby, whether you've been there before" (p. 42). Each element providing a deeper sense of context data a mobile device can draw about the user. Using GPS and WiFi data location based services can be provided providing a linkage from the digital world to the real world enabling connection to more than just data, but other people too. The second area of relevance is the advent of voice and gesture information. Smartphones and Tablets have brought touch screens to the forefront of computing. With the introduction of the iPhone 4s, a voice agent is available to process commands. And there are applications available that will do real time translations. Microsoft's Alex Kipman says, "We want to make the technology

disappear" (p. 45). Both voice and gesture technology innovations bring us closer to realizing that goal.

Feijoo, C., Pascu, C., Misuraca, G., & Lusoli, W. (2009). The next paradigm shift in the mobile ecosystem: mobile social computing and the increasing relevance of users. *Communications & Strategies*, *73*(3rd Quarter 2009), 57-77.

Abstract. Social computing has become the paradigm for the increasingly relevant role of users in the Internet world. In this paper, it is argued that mobile social computing will eventually cause an even bigger impact in the mobile ecosystem. We are already at the beginning of the "transference" of a significant part of Internet social computing usage to the mobile domain, where users are no longer passive consumers of content and applications, but co-creators and even innovators of them. However, mobile social computing will go one step further in the contribution to the development of the mobile ecosystem, since it will put the many situations of users' daily activities at the centre stage.

Credibility. Claudio Feijóo is a faculty member at CeDInt (Centro de Domótica Integral – Research Centre for Smart Buildings and Energy Efficiency) part of The Technical University of Madrid (Universidad Politécnica de Madrid, UPM) and has written 3 books and 13 papers. Gianluca Misuraca works at European Commission and Studied at École Polytechnique Fédérale de Lausanne. Misuraca joined the EU IS Unit in February 2009, focusing on the research area of ICT for governance. Wainer Lusoli is a Scientific Officer at the Joint Research Centre (European Commission), Institute for Prospective Technological Studies.

Summary. This research explores the influence of mobile social computing. Mobile social computing uses the location-based information to match content and applications to a users' environment. To examine this situation, "this paper gathers available data and evidence on the patterns of mobile social computing usage and discusses user innovation and user empowerment in the framework of the current mobile ecosystem" (Feijoo, Pascu, Misuraca, & Lusoli, 2009, p. 57). The article highlights advantages mobile computing has over the static counterpart of contextual awareness. Many mobile devices can tell if you are in motion or stationary and those inputs impact the presentation of information to the user. Through always-on connectivity and use of geo-tracking a personal relationship between the users and the mobile device soon developed. Feijóo et al. (2009) observed the rich sensing capabilities combined with always-on connectivity are augmenting the real world with the Internet while the device bears only a small compute burden due to the availability of cloud resources (p. 60).

This research identified certain barriers to adoption too: flat-rate tariff pricing for access, lower usability, smaller screen resolution, and difficulties involved with typing. Other extenuating factors noted include digital divide factors, lack of social support, privacy concerns, and prior communication technology all factor into adoption of the smart phone and tablet technology (p. 65).

They identify users as innovators in that they can create content on-the-go using mass social communications tools to create a pure form of citizen journalism (p. 67). Additionally, communities form around devices and through open source systems innovators can leverage their efforts "to increase the speed and effectiveness of testing and diffusing innovations" (p. 68).

Feijóo et al. observe,

> …three main challenges persist from the authors' perspective due to the increasingly relevant role of users in the mobile ecosystem: how to tackle the complexity of their personal involvement, the unresolved issue of their impact on the mobile value chain and business models, and meeting their expectations while safeguarding their trust. (p. 70)

Forman, G. H., & Zahorjan, J. (1994). The challenges of mobile computing. *Computer Computer*, *27*(4), 38-47. doi:10.1109/2.274999

Abstract. The technical challenges that mobile computing must surmount to achieve its potential are hardly trivial. Some of the challenges in designing software for mobile computing systems are quite different from those involved in the design of software for today's stationary networked systems. The authors focus on the issues pertinent to software designers without delving into the lower level details of the hardware realization of mobile computers. They look at some approaches under investigation and also consider their limitations.

Credibility. George Forman is a PhD candidate in the Department of Computer Science and Engineering at the University of Washington. His research interests include mobile computing and compilers for parallel computers. John Zahorjan is a professor of computer science and engineering at the University of Washington. His research interests include performance modeling and experimental evaluations, as well as issues in mobile computing, runtime support for parallel computing, and resource scheduling for continuous-media applications.

Summary. Despite the age of this article, it presents a comprehensive discussion of the key technical features and the challenges mobile computing faces today. Forman and Zahorjan group these mobile computing challenges into three categories: communication, mobility, and portability. Though designers attempt to work around these factors in their mobile computing solutions, the authors highlight opportunities for desktop applications to improve. Through identification of mobile challenges and consideration of how they are addressed there may be application of these solutions in a desktop environment. While special-purpose systems may avoid some design pressures by doing without certain desirable properties, the authors concentrate on the goal of large-scale, hand-held mobile computing as a way to reveal a wide assortment of issues.

Holzer, A., & Ondrus, J. (2011). Mobile application market: A developer's perspective. *Telematics and Informatics, 28*(1), 22–31.

Abstract. Major software companies, such as Apple and Google, are disturbing the relatively safe and established actors of the mobile application business. These newcomers have caused significant structural changes in the market by imposing and enforcing their own rules for the future of mobile application developments. The implications of these changes do not only concern the mobile network operators and mobile phone manufacturers but also bring additional opportunities and constraints for current mobile application developers. Therefore, developers need to assess what their options are and how they can take advantage of these current trends.

Credibility. Adrian Holzer is a Lecturer, University of Lausanne, Lausanne, Switzerland**.** Jan Ondrus is an Assistant Professor of Information Systems, ESSEC Business School, Cergy, France.

Summary. This paper explores how four trends in the mobile environment have implications for application development. For years, "the development of mobile services was mostly controlled and managed by the mobile network operators (MNO), phone manufacturers, and some mobile application and content providers" (p. 22). Given the advent of the Android and iPhone, the market structure and value chain is evolving and essentially allowing any able programmer into the role of a mobile application provider. Holzer and Ondrus observe the following trends in the structure: (a) a shift in portal centralization; (b) a move to technological openness; (c) increased device diversity; and (d) a move to platform integration. From these observed trends, they develop a set of implications that are impacting the traditional desktop environment.

The first trend of a centralized portal implies that *developers have easier access to the customer* as a whole. Customers purchase for their specific platform and provide an identity thread that with the purchase. The *centralized portal also lowers distribution costs*, since customers know directly where to go to find your applications. And on the negative, a *centralized portal limits the freedom of the developer*—certain portal providers require adherence to strict operational parameters to be published.

Another trend observed is the shift to technological openness. With openness mobile application *providers can expect a lower cost of development*. Open-source platforms can encourage code sharing within the open-source development community. Further, *open technology offers more career opportunities for developers*. Participation in the open-source movement does not happen in a vacuum. The open-source community members readily characterize participant contributions and assign a market value to the contributor.

Similarly, the *variety of devices available to developers implies increased freedom* in that they can likely find at least one device that supports that feature they are keen to develop. The downside of *device variety is an increased customization* costs required to support the diversity. Finally, the last trend is platform integration. Holzer and Ondrus observe, "the emergence of a fully integrated end-to-end distribution process seems to create an ecosystem with reduced compatibility issues" (p. 30). Often recognized as one of Apple's key strengths is their ability to offer an end-to-end solution that people just get because it works.

Middleton, C. (2010). Delivering services over next generation broadband networks: Exploring devices, applications and networks. *Telecommunications Journal of Australia, 60*(4).

Abstract. Investment in 'next generation' (very high speed) broadband infrastructure is expected to enable access to services that will provide citizens with social and economic benefits. Developing services for access using broadband infrastructure can be quite complicated however.

Credibility. Catherine A. Middleton is with Ted Rogers School of Management, Ryerson University, Toronto, Canada. Dr. Middleton holds a Canada Research Chair in Communication Technologies in the Information Society. Her research focuses on the development and use of new communication technologies, with specific interests in mobile devices and fixed and wireless broadband networks.

Summary. This paper explores how services can be delivered over broadband network infrastructure, outlining four broad categories of access devices, three service delivery platforms and two types of networks. Using Australian data, the paper explores user behaviors and expectations around service delivery, illustrating the need for diversity and

choice of service offerings. It also notes the importance of mobile services, and makes the case that wireless broadband connectivity should be part of a national broadband infrastructure.

Murphy, G. D. (2011). Post-PC devices: a summary of early iPad technology. *e-Journal of Business Education and Scholarship of Teaching*, *5*(1), 18–32.

Abstract. The iPad device, along with rival products signify a shift in the way in which print and other media products are purchased and consumed by users. While facing initial skepticism about the uptake of the device numerous industries have been quick to adapt the device to their specific needs. Based around a newly developed six point typology of "post-PC" device (PPD) utility this project undertook a significant review of publicly available material to identify worldwide trends in iPad adoption and use within the education sector.

Credibility. Glenn Murphy is the Managing Director at eBroadcast Australia, and is pursuing his doctoral degree from School of Management Faculty of Business, Queensland University of Technology, Brisbane, Australia. Murphy has published four journal articles and presented several conference papers on the topic of information sciences.

Summary. Murphy identified six PPD capabilities in an e-learning environment that also apply to the larger community using PPDs. Table 2 presents a list Murphy calls *typology capabilities* which are key use model characteristics of a mobile computing platform enabled by a specific tablet (or smartphone) feature.

Table 2

Typology capabilities v. tablet features

Murphy's 6-point Typology Capabilities	Tablet (or Smartphone) feature
ubiquitous access to course materials	ubiquitous content delivery
enrollment and administration	specific tasks applications
collaboration and engagement peer-to-peer / peer-to-educator collaboration	peer-to-peer collaboration, instant message, social networking
content generation	content generation (video, audio, etc.)
research and material yielding	search and content yielding
productivity enhancement	customizable productivity enhancement, pre-loaded and cloud connected app suites

The study presents empirical evidence that educational adopters are universally focused on the content delivery as a capability for this PPD platform.

West, J., & Mace, M. (2010). Browsing as the killer app: Explaining the rapid success of Apple's iPhone. *Telecommunications Policy, 34*(5-6), 270-286. doi:10.1016/j.telpol.2009.12.002

Abstract. Since the mid-1990s, the mobile phone industry has sought widespread adoption of mobile data services, envisioning a new "mobile Internet" with its own complex value network delivered through smartphone terminals. With its iPhone, Apple rapidly gained smartphone market share while spurring widespread adoption of mobile data services in the United States.

Credibility. Joel West is a Professor Emeritus at San José State University, Department of Organization and Management Instructor for entrepreneurship, high technology, and

business strategy courses. Michael Mace is a principal at Rubicon Consulting, where he's a well-known tech industry speaker, blogger, and commentator, and has appeared in the Wall Street Journal, CNN, BusinessWeek, and numerous tech industry publications. He was a keynote speaker at the Apple WWDC, and has spoken and led panels at venues including CES and CTIA.

Summary. This journal article addresses the rise of the iPhone to popularity identifying key elements of its success and how it delivered the Internet to those without a computer or computer skills. Here it is argued that the success of the iPhone was based on Apple's conception of the mobile Internet as being another modality of the existing wired Internet, and its leveraging of existing systems competencies. It is demonstrated how a promise to deliver the "real Internet" was a core part of Apple's original strategy, and that iPhone users quickly showed an interest in web browsing disproportionate to any other mobile phone in the US or Europe. From this, implications for the development of the mobile Internet in other countries are identified, as well as for future value creation and capture in mobile phone value networks.

Conclusion

With an increasingly more capable mobile computing platform, users are finding fewer reasons to return to a traditional desktop computing experience (Baudisch & Holz, 2010). Mobility provides users with the freedom to accomplish many tasks from nearly any location that were once relegated to an office or the den (Forman & Zahorjan, 1994). This annotated bibliography explores literature that examines user preferences within the mobile computing environment as a way to suggest factors for consideration by desktop application design developers. As Gebauer (2008) summarizes, there are opportunities for additional areas for research as "we see a need to assess in more detail the subtle changes that occur when users start to adapt their work-related tasks to mobile environments (cited in Zheng & Yuan, 2007)" (p. 32).

According to Kain (2012), smartphone shipments topped PC shipments by 73 million units for 2011 marking the transformation from a high-end niche product segment to a mass-market proposition. Chris Jones the VP at Canalys, says, "The greater availability of smartphones at lower price points has helped tremendously, but there has been a driving trend of increasing consumer appetite for Internet browsing, content consumption and engaging with apps and services on mobile devices" (Kain, 2012, p. 1). As consumer adoption of mobile computing platforms continues to increase, the prominence of the desktop will only diminish. To maintain the user's flow of thought, developers should strive for consistency across interfaces. Ideally, every interaction in the PC environment would harmonize user's mobile experience creating a fluid and unified experience.

Yuan and Zheng (2005) analyze "four fundamental aspects of mobile work: mobile workers, mobile tasks, mobile context, and mobile technology" (p.2). This framework is adopted here as a way to present the results of the study.

User Preferences of Smartphone and Tablet Usage in Relation to Mobile Tasks

In exploring topics on the tasks mobile platform users perform and how these tasks influence preferences (Yuan & Zheng, 2005), it is noted there are few aspects limited by the platform. Even though tasks like word processing or complex data analysis may not be ideally suited to a mobile platform, this is a result of human factors: eyesight is limited to how fine of resolution can be perceived and fingers can only manipulate to a certain level of dexterity (Baudisch & Holz, 2010). Accommodations are made and the presence of smart phones and tablets has modified how many tasks are completed (Gong & Tarasewich, 2004, p. 3751).

Basole (2008) rightly notes the importance of crafting true mobile solutions that solve business problems as opposed to applications that simply extend existing applications into the mobile space. Emphasizing the significance of user-perceived technological maturity and how that applies to an effective mobile work environment, Basole encourages a strategic perspective on how mobile applications are used in the workplace. Caus, Christmann, and Hagenhoff (2010) also note the influence on user preferences of connection to the infrastructure—enabling access to data—and access to needed applications—enabling personalization.

Gebauer (2008) determines the "need for communication, including phone and e-mail, as well as a need for productivity tools that included scheduling functionality via calendar, and contact management via an address book" (p. 27) are among functionality that users valued most. Mutchler, Shim and Ormond (2011) cite ease of use, portability and productivity along with communications as predictors of mobile technology usage satisfaction. Ackerman and Guizzo (2011) observe that "more than 250 million users access Facebook on their mobile devices, and more than 40 percent of all tweets com e from mobile platforms" (p. 42). While social networking tools like Twitter and Facebook enable instant communication to audiences narrow

and broad, applications like Foursquare leverage the positional information of mobile communications to facilitate tasks of social event coordination in real-time (Cranshaw, Toch, Hong, Kittur, & Sadeh, 2010; Feijoo, Pascu, Misuraca, & Lusoli, 2009). Further, Feijoo et al. (2009) find consumers derive a sense of "context (place, environment, emotional situation, social relationships, etc.)" through the use of these social tools—a compelling feature they believe is certain to drive adoption, especially in the youth market.

Environmental Use Factors that Frame the Mobile Context

The majority of mobile phone usage occurs within a specific context: "There is a location, the day and time, what you're doing there, what is nearby, whether you've been there before" (Ackerman & Guizzo, 2011, p. 42). In addition to the physical environment, the context of usage includes the ecosystem the mobile device operates within including their user interface, connectivity providers and application offerings, and delivery system (Basole, 2011).

One frequently cited aspect of the mobile ecosystems is the app store (Babb & Abdullat, 2011; Brugnoli, Hamard, & Rukzio, 2005; Caus, Christmann, & Hagenhoff, 2010; Middleton, 2010; Ryan & Gonsalves, 2005; West & Mace, 2010) and its importance to the success of a mobile platform. Users expect to be able to customize and extend the utility of their devices through accessing more capable software than may have been delivered on the initial platform (Caus, Christmann, & Hagenhoff, 2010). In addition to access to extended functionality, the advent of the app store brings the user a sense of personalization (Forman & Zahorjan, 1994). Middleton (2010) observes, "apps change the dynamic of internet access, moving away from a browser-based routine to provide users a richer experience" (p. 7). Making transparent the layer of the internet by removing the need for a browser or a web address, users interact directly with an app that provides the desired content to the device. No longer do consumers have to browse to

a URL for the local radio station, locate the playback link, and then start some version of a web media player that may or may not work to start streaming content—they click the app and the streaming commences (Middleton, 2010).

Concerning personalization, Brugnoli, Hamard and Rukzio (2005) suggest mobile users find "certain services characteristics evoke a sense of presence, the sensation of being in a familiar, tangible, comforting environment" (p. 12) further asserting this "perception played a key role in making the service appealing as well as adding to their sense that it was fully developed and dedicated to serving users" (p. 12). This perceived familiarity directly fosters a connectedness between the app and the user.

Zhou (2011) proposes and evaluates 14 observations about users and their continued usage of mobile services and finds 13 are supported by the results of the research. Seven of these observations directly address expectations and perceptions as they relate to ease of use and continuance intention:

- Expectation confirmation significantly affects perceived usefulness.
- Expectation confirmation significantly affects user satisfaction.
- Perceived usefulness significantly affects user satisfaction.
- Perceived usefulness significantly affects continuance intention.
- Perceived ease of use significantly affects perceived usefulness.
- Perceived ease of use significantly affects user satisfaction.
- Perceived ease of use significantly affects continuance intention.

Zhou's results demonstrate that characteristics of expectation confirmation, perceived ease of use, and perceived usefulness have significant effects on user preferences.

Security and privacy in a mobile context are two areas that are granted a relaxed stance from a user's perspective (Brugnoli, Hamard, & Rukzio, 2005). In the mobile environment users hold an implicit trust in the wireless connectivity providers and app providers like banks and credit card companies to provide secure services (Mascolo, 2010; Tarasewich, Gong, Nah, & DeWester, 2008). With content most likely residing in the cloud computing space, there are inherent security and privacy risks in the transmission of data to and from the mobile platform (Forman & Zahorjan, 1994; Mascolo, 2010; Tarasewich, Gong, Nah, & DeWester, 2008).

User Preferences of Technical Features of Mobile Devices (smartphones and tablets)

Portable computers have been available since the early days of personal computing, but have entailed the transport of a computer and establishing a communication connection (West & Mace, 2010). Today's mobile devices feature capabilities that exceed the desktop PC from only a few years back (Yuan & Zheng, 2005). Mobile platforms offer (a) compelling technical features for mobile device users (Ackerman & Guizzo, 2011), (b) technical features that are unique to mobile computing (Baudisch & Holz, 2010), and (c) technical capabilities that influence user preferences (Feijoo, Pascu, Misuraca, & Lusoli, 2009). Compelling mobile features include storage capacity, touch input, two-way video and interactive speech or gesture control (Ackerman, E., & Guizzo, E., 2011) in addition to the less obvious aspects like haptic response, accelerometers, GPS and continuous connectivity that enables social tracking (Feijóo et al., 2009).

Mobility presents different challenges than a stationary computing platform. Forman and Zahorjan observe "that as people move, their mobile computers will use different network access points" (1994, p. 42). Mobility introduces variability in many aspects, some of which are common to desktop systems as encountered with network configurations that involve multiple

gateways to the internet, and others which are unique to a transient location (Forman & Zahorjan, 1994). Portability is another aspect distinctly different than a desktop configuration, yet again there are relevancies between the solutions for either environment including power consumption, risks to data, user interface configurations, and limited onboard storage capacities (Holzer & Ondrus, 2011; West & Mace, 2010).

Users seek to have efficient devices whether these are desktop or handheld. It is only natural that as users shift to a mobile experience, they adopt preferences that extend to the larger computing environment. Awareness of these mobile feature preferences may enable desktop software developers the opportunity enhance their offerings by harmonizing the environments to provide a more consistent user engagement.

References

Ackerman, E., & Guizzo, E. (2011). 5 technologies that will shape the web. *IEEE Spectrum*, *48*(6), 40-45. doi:10.1109/MSPEC.2011.5779788

Admob. (2010, May). AdMob mobile metrics report. Retrieved from http://metrics.admob.com/wp-content/uploads/2010/06/AdMob-Mobile-Metrics-May-10.pdf

Babb Jr, J. S., & Abdullat, A. (2011). The need for mobile application development in IS curricula: An innovation and disruptive technologies perspective. *2011 ISECON Proceedings* (Vol. 28, p. 14). Presented at the Information Systems Educators Conference, Wilmington North Carolina, USA: EDSIG (Education Special Interest Group of the AITP). Retrieved from www.aitp-edsig.org

Basole, R. C. (2008). Enterprise mobility: Researching a new paradigm. *Information, Knowledge, Systems Management*, *7*(1), 1-7.

Basole, R. C., & Karla, J. (2011). On the evolution of mobile platform ecosystem structure and strategy. *Business & Information Systems Engineering*, *3*(5), 313-322. doi:10.1007/s12599-011-0174-4

Baudisch, P., & Holz, C. (2010). My new PC is a mobile phone. *XRDS*, *16*(4), 36-41. doi:10.1145/1764848.1764857

Bell, C., & Smith, T. (2009, May 19). Critical evaluation of information sources. *Critical evaluation of information sources (University of Oregon Libraries)*. Retrieved November 8, 2011, from http://libweb.uoregon.edu/guides/findarticles/credibility.html

Blackwell, A. F., & Fincher, S. (2010). PUX: Patterns of user experience. *Interactions*, 17(27), doi:10.1145/1699775.1699782

Brugnoli, M. C., Hamard, J., & Rukzio, E. (2005). User expectations for simple mobile ubiquitous computing environments. *Mobile Commerce and Services, 2005. The Second IEEE International Workshop on* (pp. 2-10). Presented at the WMCS '05, Munich: IEEE. doi:10.1109/WMCS.2005.27

Busch, C., De Maret, P. S., Flynn, T., Kellum, R., Le, S., Meyers, B., Saunders, M., et al. (2011). Writing guide: Content analysis. *Content Analysis*. Writing@CSU. Colorado State University. Retrieved December 15, 2011, from http://writing.colostate.edu/guides/research/content/printformat.cfm?printformat=yes

BusinessDictionary.com. (n.d.). Retrieved November 15, 2011, from http://www.businessdictionary.com/

Caus, T., Christmann, S., & Hagenhoff, S. (2010). Empirical assessment on user acceptance of mobile applications deployment. *2010 Ninth International Conference on Mobile Business and 2010 Ninth Global Mobility Roundtable* (pp. 243-250). Presented at the 2010 Ninth International Conference on Mobile Business and 2010 Ninth Global Mobility Roundtable, Athens, Greece: IEEE. doi:10.1109/ICMB-GMR.2010.14

Chandrakasan, A. P., Sheng, S., & Brodersen, R. W. (1992). Low-power CMOS digital design. *Solid-State Circuits, IEEE Journal of*, *27*(4), 473–484. doi:10.1109/4.126534

Collotta, M., Pau, G., Salerno, V. M., & Scatà, G. (2011). iOS applications to improve learning and management system in a university campus. *International Journal of Computer Science and Network Security*, *11*(3), 262-268.

Cranshaw, J., Toch, E., Hong, J., Kittur, A., & Sadeh, N. (2010). Bridging the gap between physical location and online social networks (p. 119). ACM Press. doi:10.1145/1864349.1864380

Creswell, J. (2009). *Research design : qualitative, quantitative, and mixed method approaches* (3rd ed.). Thousand Oaks: Sage Publications.

Feijoo, C., Pascu, C., Misuraca, G., & Lusoli, W. (2009). The next paradigm shift in the mobile ecosystem: mobile social computing and the increasing relevance of users. *Communications & Strategies*, *73*(3rd Quarter 2009), 57-77.

Fischer, G. (2003). Desert island: Software engineering—a human activity. *Automated Software Engineering*, *10*(2), 233-237.

Forman, G. H., & Zahorjan, J. (1994). The challenges of mobile computing. *Computer Computer*, *27*(4), 38-47. doi:10.1109/2.274999

Gebauer, J. (2008). User requirements of mobile technology: A summary of research results. *Information Systems and e-Business Management*, *6*, 361-384.

Graf, D. K., & Misic, M. M. (1994). The changing roles of the system analyst. *Information Resources Management Journal*, *7*(2), 15–15.

Grasso, D., & Martinelli, D. (2007). Holistic engineering. *The Chronicle Review*, *53*(28), B8.

Grimmelmann, J., & Ohm, P. (2010). Dr. Generative or : How I learned to stop worrying and love the iPhone. *Maryland Law Review*, *69:910*(Seq. 3), 910-953.

Gong, J., & Tarasewich, P. (2004). Guidelines for handheld mobile device interface design. *In Proceedings of the 2004 DSI Annual Meeting* (pp. 3751–3756).

Heijden, H., (2003). Factors influencing the usage of websites: the case of a generic portal in the Netherlands. *Information & Management*, 40, 541–549.

Herold, D. K. (2010). Imperfect use? ICT provisions and human decisions: An introduction to the special issue on ICT adoption and user choices. *The Information Society*, *26*(4), 243-246. doi:10.1080/01972243.2010.489497

Heymans, J. J., & Baird, D. (2000). Network analysis of the northern Benguela ecosystem by means of NETWRK and ECOPATH. *Ecological Modelling, 131*, 97-119. doi:10.1016/S0304-3800(00)00275-1

Holzer, A., & Ondrus, J. (2011). Mobile application market: A developer's perspective. *Telematics and Informatics*, *28*(1), 22–31.

IT definition and glossary. (n.d.). *IT Definitions and Glossary*. Retrieved December 18, 2011, from http://www.gartner.com/technology/it-glossary/

Kain, E. D. (2012, February 4). Smartphone shipments top PCs for the first time ever. *Forbes*. Retrieved February 8, 2012, from http://www.forbes.com/sites/erikkain/2012/02/04/smartphone-shipments-top-pcs-for-the-first-time-ever/

Koivumäki, T., Ristola, A., & Kesti, M. (2008). The effects of information quality of mobile information services on user satisfaction and service acceptance–empirical evidence from Finland. *Behaviour & Information Technology*, *27*(5), 375-385. doi:10.1080/01449290601177003

Lee, A. (2009). Mobile web widgets: Enabler of enterprise mobility work. *2nd Workshop on Mashups, Enterprise Mashups and Lightweight Composition on the Web*. Presented at the MEM 2009, Spain.

Liu, Y. W. (2009, June). *The implication of open innovation and open source to mobile device manufacturers*. Massachusetts Institute of Technology.

Mascolo, C. (2010). The power of mobile computing in a social era. *Internet Computing, IEEE, 14*(6), 76-79.

McDowell, M. (2008). Business mobility: A changing ecosystem. *Information Knowledge Systems Management, 7*(1/2), 25-37.

Middleton, C. (2010). Delivering services over next generation broadband networks: Exploring devices, applications and networks. *Telecommunications Journal of Australia*, *60*(4).

Müller, R. M., Kijl, B., & Martens, J. K. J. (2011). A comparison of inter-organizational business models of mobile app stores: There is more than open vs. closed. *Journal of Theoretical and Applied Electronic Commerce Research*, *6*(2), 63-76. doi:10.4067/S0718-18762011000200007

Murphy, G. D. (2011). Post-PC devises: a summary of early iPad technology. *e-Journal of Business Education and Scholarship of Teaching*, *5*(1), 18–32.

Murphy, M., & Meeker, M. (2011, February 10). *Top mobile internet trends*. Retrieved from http://www.slideshare.net/kleinerperkins/kpcb-top-10-mobile-trends-feb-2011

Mutchler, L. A., Shim, J. P., & Ormond, D. (2011). Exploratory study on users' behavior: Smartphone usage. *Proceedings of the Seventeenth Americas Conference on Information Systems* (p. 10). Presented at the Americas Conference on Information Systems (AMCIS) 2011, Detroit, Michigan: AIS Electronic Library (AISeL). Retrieved from http://aisel.aisnet.org/amcis2011_submissions/418

Nielsen. (2011, November 3). Generation app: 62% of mobile users 25-34 own smartphones. *nielsenwire*. Retrieved from http://blog.nielsen.com/nielsenwire/online_mobile/generation-app-62-of-mobile-users-25-34-own-smartphones/

OReilly, T. (2007). What is web 2.0: Design patterns and business models for the next generation of software. *Communications & Strategies*, *65*(1st Q. 2007), 17-37.

Petter, S. (2008). Managing user expectations on software projects: Lessons from the trenches. *International Journal of Project Management*, *26*(7), 700-712. doi:10.1016/j.ijproman.2008.05.014

Pijpers, V., Gordijn, J., & Akkermans, H. (2008). Business strategy-IT alignment in a multi-actor setting (p. 1). ACM Press. doi:10.1145/1409540.1409551

Querbes-Revier, A. (2011). The collective construction of digital platforms for mobile services: The mobile OS for smartphones. *Evolutionary Perspectives on Technical Change and Industrial Dynamics* (p. 25). Presented at the EMAEE 2011: 7th European Meeting on Applied Evolutionary Economics, Sant'Anna School of Advanced Studies, Pisa. Retrieved from http://www.lem.sssup.it/WPLem/documents/papers_EMAEE/querbes_revier.pdf

Ryan, C., & Gonsalves, A. (2005). The effect of context and application type on mobile usability: an empirical study. *Proceedings of the Twenty-eighth Australasian conference on Computer Science - Volume 38* (Vol. 38, pp. 115-124). Presented at the Conferences in Research and Practice in Information Technology, Newcastle, Australia: Australian Computer Society, Inc.

Sharma, K. (2011). Android in opposition to iPhone. *International Journal on Computer Science and Engineering (IJCSE)*, *3*(5), 1965-1969.

Shaw, M. (1990). Prospects for an engineering discipline of software. *IEEE Software*, *7*(6), 15-24. doi:10.1109/52.60586

Sheard, S. A. (1996). *Twelve systems engineering roles*.

Shi, D. (n.d.). Feature phones: What is a feature phone? Retrieved December 7, 2011, from http://www.quora.com/Feature-Phones/What-is-a-feature-phone

Smith, D. G. (2008, November 19). Literature reviews. Claremont Graduate University.

Sudhakar, G. P. (2010). *Elements of software project management*. New Delhi: PHI Learning Private Limited.

Tarasewich, P., Gong, J., Nah, F. F.-H. & DeWester, D. (2008). Mobile interaction design: Integrating individual and organizational perspectives. *Information Knowledge Systems Management, 7*(1/2), 121-144.

The Free Dictionary. (1981, 2011). *Computer desktop encyclopedia*. Retrieved December 28, 2011, from http://www.thefreedictionary.com/

Thottam, J. (2005, April 4). How kids set the (ring) tone. *Time*, *165*(14), 30-31.

University of North Carolina. (n.d.). *Writing center: Literature reviews*. Retrieved from University of North Carolina at Chapel Hill, Writing Center Web site: http://www.unc.edu/depts/wcweb/handouts/literature_review.html

Vega, J. (2010). *Effect of web design on the overall success of web sites*. College of Liberal Arts, California Polytechnic State University.

West, J., & Mace, M. (2010). Browsing as the killer app: Explaining the rapid success of Apple's iPhone. *Telecommunications Policy*, *34*(5-6), 270-286. doi:10.1016/j.telpol.2009.12.002

Willis, D. (2011, April 13). *iPad and beyond: the media tablet in business*. PDF presented at the Gartner Symposium/ITxpo: The world's most important gathering of CIOs and senior IT executives, Cape Town, South Africa. Retrieved from http://www.gartner.com/it/content/1586600/1586614/april_13_ipad_and_beyond_dwillis.pdf

Wixom, B. H., & Todd, P. A. (2005). A theoretical integration of user satisfaction and technology acceptance. *Information systems research*, *16*(1), 85–102.

Xia, R., Rost, M., & Holmquist, L. E. (2010). Business models in the mobile ecosystem. *2010 Ninth International Conference on Mobile Business and 2010 Ninth Global Mobility Roundtable* (pp. 1-8). Presented at the 2010 Ninth International Conference on Mobile Business and 2010 Ninth Global Mobility Roundtable, IEEE. doi:10.1109/ICMB-GMR.2010.30

Yuan, Y., & Zheng, W. (2005). From stationary work support to mobile work support : A theoretical framework. *Mobile Business* (pp. 315-321). Presented at the International Conferences Mobile Business 2005, IEEE. doi:10.1109/ICMB.2005.42

Zhou, T. (2011). An empirical examination of users' post-adoption behaviour of mobile services. *Behaviour & Information Technology, 30*(2), 241-250. doi:10.1080/0144929X.2010.543702